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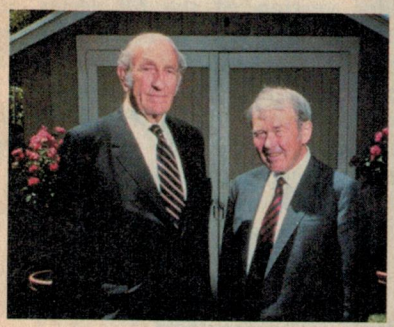
Volume 59, No.10
October 1997

AUSTRALIA'S LARGEST SELLING ELECTRONICS MAGAZINE — ESTABLISHED IN 1922

Four instruments in one

The Metex MS-9150 is basically four useful test instruments in one: an 85W triple-output regulated supply, a 1.3GHz frequency counter, a 2MHz function generator and a 3-3/4 digit DMM. And the price is much lower than you'd expect — somewhat less than four similar instruments purchased separately, in fact. Our hands-on report starts on page 118.

Discovering 'The HP Way'



Why has the company founded by Bill Hewlett and Dave Packard back in 1939 been so successful? Jim Rowe was able to visit some of their T&M facilities recently, meeting some of the people behind the products, and now thinks he understands the famous 'HP Way' and how it works. His story begins on page 22...

On the cover

Production engineers at the B&W Speakers factory in the UK fit a bass driver into the shell of one of their high-end Nautilus systems — which have been described as 'the best loudspeakers that money can buy'. See Louis Challis' report on his visit to B&W, starting on page 10. (Photo courtesy Convoy International)

World of Electronics

Projects and Technical

Columns and Comments

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ELECTRONICS AUSTRALIA is published by Federal Publishing Company, a division of Eastern Suburbs Newspapers Partnership, which is owned by
General Newspapers Pty Ltd.
A.C.N.000 117 322,
Double Bay Newspapers Pty Ltd.
A.C.N.000 237 598, and
Brehmer Fairfax Pty Ltd.
A.C.N.008 629 767,
180 Bourke Road, Alexandria, NSW 2015.

Printed by Macquarie Print, 51 - 59 Wheelers Lane, Dubbo 2830. Phone (068) 843 444.
Distributed by Newsagents Direct Distribution Pty Ltd, 150 Bourke Rd, Alexandria 2015; phone (02) 9353 9911.
ISSN 1328-6218
* Recommended & maximum Australian retail price.

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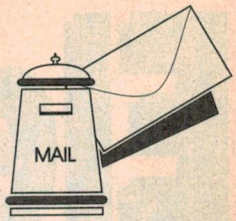
LETTERS TO THE EDITOR



Fair Go responds

Mr P. Ryan's letter to 'Forum' in August contained a number of innacuracies, the least of which is that Fair Go is 'not famous for being accurate in its presentation'. In our 20 years on air Fair Go has built a formidable reputation on being accurate.

Mr Ryan also inaccurately claimed our programme included the opinions of Bruce Rapley, representing the Production Technology department of Massey University. How on earth he came to that conclusion I don't know, because Mr Rapley did not appear in the programme, nor was he quoted. Mr Ryan also mentioned Martin Gledall of the National Radiation Laboratory in Christchurch and added 'a bit of a worry these experts'. Martin Gledall is a well respected New Zealand scientist and well qualified in his field.

For your readers' information our investigation into electronic pest devices tested the claims made by manufacturers to consumers. The manufacturers claimed the devices killed all pests including cockroaches — in our tests no cockroaches were killed. They claimed to emit an electromagnetic field from house wiring — we could not find it. They claimed the devices killed dust mites — the Wellington Medical School's Asthma Research Dept found the devices had no effect on their dust mite colony.

We offered the manufacturers the opportunity to prove their claims, but their only response was anecdotal.

The issue of EMF fields and pest control is murky to say the least, but until manufacturers can properly prove their claims, consumers deserve protection and we will continue to rely on the opinions of recognised national experts.

Raewyn Rasch, Reporter
Fair Go,
Kotuku Productions
Lower Hutt, New Zealand.

MC68705P3 cloning

I am writing to you in the hope you will reprint this letter to see if any of your readers will be able to help me with the following problem.

Recently I was given an electronically controlled golf trundler to fix. The unit was manufactured in Canada, is called a 'Lectronic Caddy' and is powered by a 12V motor for each wheel. It has speed and timer controls.

Unfortunately the manufacturer has long since gone out of business, however I was able to track the cause of why the machine was not working. Namely a couple of IC's had gone haywire — which in turn appeared to have corrupted the main 68705P3 microcontroller/EPROM. Fortunately I have been able to locate a functional micro from another user of the same machine, but so far I cannot find any way to copy the programme into a binary file so that I can reprogramme a new one for my customer.

After reading the article in *EA* May by Peter Philips about Oztechnics' 68HC05 development system, I decided to ask around and have already had some excellent help and advice from several people in Australia. This micro is an older version of the 68 series and although it appears to not have a programmable security bit, it does seem to be unreadable. I would be grateful to hear if anyone out there has actually read back one of these devices or can provide a copying service.

James E. Newman
49 Vine Ave, (fax 07 544140)
Tauranga, NZ
(email james.new@xtra.co.nz)

Risk exaggerated

I am an electrical engineering student, not employed by any of the telephone companies. I have been following the articles and letters on the subject of EM radiation risks from mobile telephones, and I must say I'm a little concerned.

Last year roughly 300 pedestrians were killed and many more injured on our roads. I don't know the figures for drivers or passengers, but I suspect they are around the same. Recently, I have seen several articles in the press and on TV about protests against mobile phone towers; but none about having cars banned, or smoking.

Don't get me wrong, I'm not saying that mobile phones are definitely safe. But in an age where the air, food and water are all carcinogenic, and you can

get killed walking down the street by cars or muggers (not to mention the 101 ways to die just in your own home!), I think that the risks from a mobile telephone are little over-rated.

By all means treat your mobile telephone with respect, but get it into perspective: you could be dead in half an hour having never used a mobile in your life.

Simon Green
Emu Heights, NSW.

Desoldering tool

I refer to an article appearing in the July issue 'The Serviceman', which refers to the Den-on SC5000 desolder instrument. As the Australian distributor for Den-on Instrument Co., we are concerned to set the record straight on the developments of the instrument in question over recent years.

Firstly the SC5000 was introduced on the Australian market in 1990, and the original version of the tool was modified shortly after introduction, by insertion of an 'isolation pad' between the motor and the PCB, which rectified the possibility of the occurrence which your article outlines. I attach schematic diagrams for your information, which show the early version and the modified version of the SC5000. Subsequently the SC5000 was rendered obsolete in 1991 by the introduction of a new and improved model, the SC7000; this model has been sold in significant numbers since that time, and presently is known as the SC7000Z. We are not aware of any problems with this instrument.

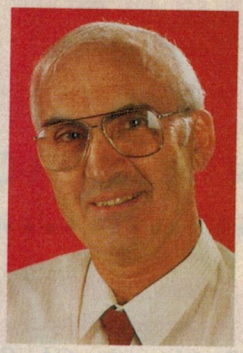
We are prepared to offer a generous trade-in on a new SC7000Z to any of your readers who have an SC5000 tool that they may wish to upgrade.

According to the manufacturers the life span of this type of desolder tool is expected to be approximately five years. However some customers will use the tool more intensely than others, and this therefore will impact on the life of the tool. We would appreciate hearing from any of your readers who have any comments to offer on the performance of the tool.

Michael A. O'Neill
Managing Director
Mektronics Co Pty Ltd
84B Industrial Drive,
Braeside, Vic 3195. ❖

Letters published in this column express the opinions of the correspondents concerned, and do not necessarily reflect the opinions or policies of the staff or publisher of Electronics Australia. We welcome contributions to this column, but reserve the right to edit letters which are very long or potentially defamatory.

EDITORIAL VIEWPOINT



Let's be VERY careful before we accuse people...

This isn't the original comment I wrote for this issue, but a last-minute replacement. A very sad event occurred only a few days before this issue was going to press, an event which I found very disturbing — and one which seems to cry out for a response from industry media like *Electronics Australia*.

The event concerned was the death, allegedly by suicide, of an electronics service technician in Sydney following an item concerning him carried by a popular TV current affairs program. Of course I cannot make any comments about this particular case, because that would be improper. However I do believe it's important that a few general comments should be made in the interests of fairness and objectivity with regard to any situation of this type.

Firstly, it should be stressed that electronics servicing is an occupation which is not clearly understood by the majority of consumers. A lot of people simply don't appreciate how much skill and experience is required to troubleshoot and repair many familiar items of 'domestic' electronics gear, or how much test equipment is required to do the job efficiently — let alone how much time it can take to track down elusive faults. It is therefore all too easy to jump to the conclusion that we're being 'ripped off' when a repair bill is higher than we might have expected. But the fact is that in probably the vast majority of cases, such a conclusion would be *wrong*.

No one would deny that there are dishonest service technicians, just as there are dishonest people in all walks of life. But the reality is that such people are only a small minority; the majority of people in the electronics servicing industry are honest and very hard working — and if anything, probably not receiving *enough* for their labours and investment.

I believe it's also very important to stress that if anyone is going to try and 'test' the capability and/or honesty of any service organisation or technician, they should be *extremely* cautious both about creating 'simulated faults' in equipment, and then drawing conclusions on the basis of the time taken to find and rectify such faults — and therefore the ensuing charge.

The fact is that most 'real' faults that occur in electronic equipment are due to a relatively small number of basic failure mechanisms, even though these can apply to many different specific components and sometimes produce quite confusing and misleading symptoms. This means that unless a 'fake' fault is designed with great care to accurately simulate a typical failure mechanism, it could easily prove much harder and more time consuming to track down than a *real* fault.

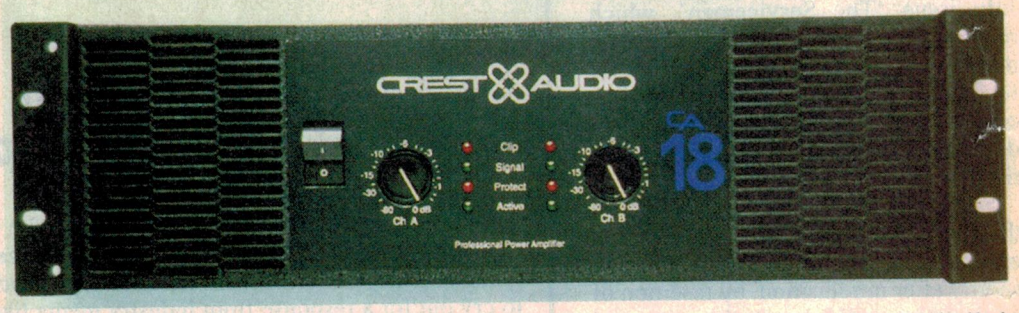
These two considerations alone should be sufficient to make anyone extremely cautious before they jump to any conclusions about allegations of overcharging or malpractice on the part of service organisations or technicians — especially when such allegations can be responsible for very sad consequences.

Jim Rowe

WHAT'S NEW

IN THE EVER-CHANGING WORLD OF ELECTRONICS

Professional power amplifiers



Crest's new CA Series Power Amplifiers are claimed to deliver an unparalleled combination of sonic accuracy, high performance output and ability to handle difficult loads — plus Crest's legendary 'overbuilt' power supply. The units are based on Crest's reputation for high quality and fail-safe reliability, established after many years on the world's premier concert tours.

The design includes class H amplification stages on most models and the latest generation of high speed, wide bandwidth output transistors for wide-open, transparent high frequency reproduction.

The thermal management system maintains optimum performance with twin-tunnel cooling by dual high-performance, variable speed DC fans and temperature sensors on both heatsinks and the power supply transformer.

A toroidal transformer is used for a better power/weight ratio and lower ambient and electrical noise.

CA Series amplifiers will operate into loads as low as 2Ω for extended duty cycles, and even lower for brief periods, without overstressing output stages or endangering speakers. The built-in Instantaneous Gain Modulation circuit instantly adapts to conditions by gently lowering input levels.

For more information contact distributor Jands Electronics, or circle 145 on the reader service coupon.

3D sound from your PC

Labtec's LCS-9210 Imager 3D Audio System makes it possible to get surround sound from ordinary computer speakers, adding a new dimension to all of your favourite games. It incorporates the latest advancements in 3D stereo technology and can also be used with stereo systems, allowing you to record in dynamic 'Spatialiser 3D Stereo' or '3D Mono' sound.

The unit is compatible with both the Dolby Pro Logic and Dynaco Surround Sound Systems. A variable space control allows spatial adjustment for personal preference, while a convenient bypass button allows you to engage or disengage the spatial effect.

There is no software to install or drivers to configure; everything needed for a hassle-free installation is included in the package, which has an RRP of $89. Further information is available from Australian distributor VideoCam Accessories, at PO Box 2000, Strawberry Hills 2012; phone (02) 9698 1470.

Epson projector offers XGA resolution

Epson has announced what it claims is the world's first truly portable, high performance multimedia projector offering true XGA (1024 x 768 pixel) resolution. The EMP-7000 is said to provide an image intensity of 400 ANSI lumens, yet only weighs 6.6kg — giving users the power to create a dynamic presentation anywhere, anytime.

The EMP-7000 incorporates Epson's own patented SizeWise technology, allowing it to accept every major notebook computer display resolution — even 1280 x 1024 (SXGA). SizeWise also re-sizes SVGA and VGA to XGA, for those times when presenters want to use different resolutions. It can also accept video signals from VCRs, laserdisc players etc., automatically detecting PAL, NTSC or SECAM formats.

The EMP07000 uses three poly-silicon LCD panels each of 1024 x 768 pixel resolution. This gives a total of almost 2.4 million pixels, compared with other 'XGA' projectors which use only 786,000 pixels.

Other features include 'Spatializer 3D Sound' and the Chronos high efficiency lamp system using a 150W metal halide lamp (lamp life approximately 2000 hours).

The EMP-7000 has an RRP $18,299 including tax, and comes with a 12-month national warranty. For more information circle 142 on the reader service coupon.

New range of camcorders from Hitachi

Hitachi has released a new family of 8mm video camcorders, incorporating many new features. The range offers five models, from the entry level VM-E230E up to the fully featured VM-H835LE with Hi8, HiFi Stereo, 3" LCD display, a 570,000 pixel CCD, advanced battery and display technology, and digital processing for the highest quality in panel display.

Perhaps the greatest advance to be found in the new range is the use of lithium ion (Li-ion) battery technology, in all but the entry-level model. Li-ion offers several advantages over the traditional NiCad battery; in particular it holds its charge longer and is free of annoying memory effects.

Hitachi quote two hours of record time using their standard Li-ion battery, over 30 minutes more than similar priced competitors using cheaper (and much larger!) NiCad batteries. Recharge time is much faster than NiCads, which lets users get back to filming faster.

Hitachi has also incorporated new lens technology in the camcorders, adapted from their professional TV cameras. This takes the form of a 16X optical zoom plus digital zoom to 200X, with a wide angle capability to 48°. The ability to film in low light has also been enhanced with a maximum aperture of f/1.4.

Also to be found in two of the new camcorders is the company's new Super TFT LCD technology, with wide viewing angle and ultra thin design. Both the VM-E535LE and the VM-H835LE feature a 3" LCD screen incorporating TFT Active Matrix technology and an industry leading 90,000-pixel resolution, for superior viewing. The LCD panel can be swivelled out for normal viewing or turned to face out of the camera body for easy display on playback.

The new Hitachi 8mm camcorders are available now from leading retailers, at RRPs ranging from $999 to $2299. For more information circle 140 on the reader service coupon.

New higher-res digital still camera

Epson has released its most advanced digital still camera yet, the PhotoPC 600. The new model captures high resolution 1024 x 768 pixel images (also known as XGA resolution), and is claimed to redefine the performance and functionality of digital cameras by delivering a unique set of features.

The easy-to-use PhotoPC 600 is an auto-focus camera which uses advanced image processing and enhancement algorithms to deliver excellent colour accuracy, saturation, balance and contrast. It also features auto-exposure and a built-in automatic flash. A built-in 50mm active matrix colour LCD monitor can be used both as a viewfinder and to review pictures already taken.

Additional options include setting the camera's date and time, turning the beep on or off, displaying picture information, deleting or locking pictures taken, displaying the pictures as a slideshow and other functions. To guard against fingerprints and damage from sharp objects, the LCD also sports a protective cover.

The PhotoPC 600 also has the ability to print directly to Epson's award-winning Stylus Photo six-colour inkjet printer, designed specifically for digital photography.

Portable and lightweight, the PhotoPC 600 measures only 142 x 71 x 48mm (WxHxD). The internal memory can store up to 50 standard VGA, 16 Fine XGA or seven SuperFine XGA resolution images. The PhotoPC 600 also supports optional removable and reusable ATA-compatible Compact Flash storage cards. More information is available on Epson's website at **http://www.epson.com**.

Jamo speakers are also artwork

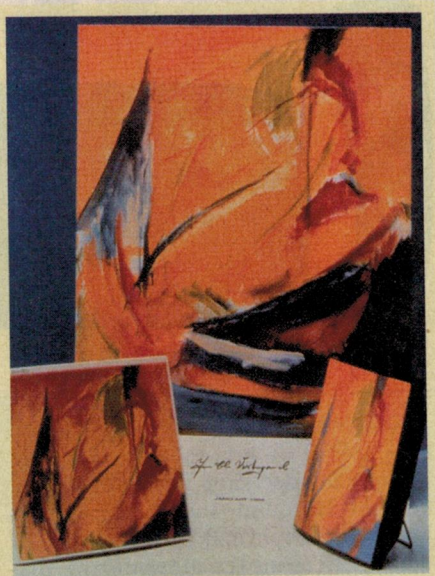
The latest 'Deco-Art' loudspeakers from Jamo of Denmark provide a colourful contemporary artwork to 'add colour' to your music. Jamo claims to be Europe's largest and most innovative loudspeaker manufacturer, and the Deco-Art is the newest member of its designer speaker range.

Based on the long established 'Art' model, the Deco-Art was created by Jamo commissioning a well known Danish artist to produce an exclusive contemporary artwork. The result is a strikingly colourful design that is claimed to suit the decor of many rooms. The artwork is on the grille cloth of the cabinet, which is available in either black or white.

To complement the speakers a limited edition print of the same artwork, on high quality paper-stock, comes with each pair of speakers.

On the technical side the Deco-Art speakers feature a two-way bass reflex design with 133mm woofer and 25mm tweeter. The long term power handling is 60 watts.

The speakers retail for $899 per pair and come with a five year warranty. They are available from selected Jamo stockists around Australia. For further information contact distributor Scan Audio on 1800 700708 or circle 147 on the reader service coupon.



Brother's new 'Multi-Function Centre'

Brother's new MFC-1970MC Multi-Function Centre is effectively seven devices in one: a plain paper fax, printer, scanner, copier, PC Fax, Message Centre (incorporating a digital answering machine) and telephone. Brother claims it's the 'ultimate office machine' for the budget-conscious SOHO user, especially in view of its RRP of only $999.

The unit has a 200-sheet plain paper cassette and includes a large 1MB memory to store up to 50 pages of fax messages or 30 minutes of voice messages. The memory can also be used for time saving features such as broadcasting, 'next fax' reservation and reception when the paper is exhausted. Other quality fax features include a 20-page auto document feeder, a 14.4kb/s modem, 124-number automatic dialling and a hands-free speaker phone.

The MFC-1970MC's exclusive Message Centre function includes a digital answering machine, five mailboxes to store private fax and voice messages, fax forwarding and remote fax and voice retrieval.

The MFC-1970 can also operate as a convenience printer, scanner, copier and PC Fax. Documents can be printed from Windows 3.1 or '95 and also scanned directly into the computer. The unit's advanced copying capabilities include multi-copying up to 99 pages, sorting and reduction down to 50% and enlargement up to 150%.

Using the PC Fax function, users also can save time and money by not having to print out a hard copy of the fax before sending it or receiving it directly into the PC.

For more information contact your local Brother Industries state office or circle 143 on the reader service coupon.

Multi-format digital satellite receiver

Hyundai's new HSS-100C MPEG satellite receiver is claimed to be the first domestic 'format agile' digital receiver to arrive on the Australian market. The main benefit of this is its ability to handle both European and American strains of the digital standard, said to be currently reaching Australasia from a multitude of satellites.

Although essentially manufactured for the enormous Chinese market, the HS-100C is said to receive most of the current free to air digital TV stations available in the Pacific region. It is also capable of SCPC (single channel per carrier) and MCPC (multiple channel per carrier) compatibility, with a symbol rate going down to almost zero to cater for the multitude of Chinese domestic (and Asian) TV stations.

The receiver has provision for future expansion to conditional access. The menu presents as a multilingual 16-colour display and carries an electronic programme guide. The receiver's output is in PAL D format, which can be fed into a TV receiver or VCR using standard AV inputs.

The RRP of the receiver is $1295. For more information contact Cablesat Electronics on (060) 406185 or fax (060) 405317 (email to **cablesat@albury.net.au**).

Kenwood AV receivers decode Dolby Digital

Kenwood's latest KR-V999D and KR-V888D home theatre receivers offer inbuilt decoding for Dolby Digital (AC-3) surround sound as well as Dolby Pro-Logic and DSP.

By delivering six independent, discrete channels of sound, Dolby Digital (AC-3) lets you enjoy stereo surround sound as full and satisfying as the best of theatre sound, from material which is encoded with this system. Dolby Digital (AC-3) is the audio signal format for the latest media such as high-definition TV (HDTV) and some digital video discs (DVD) — although not those to be sold in Australia, it would appear.

The powerful KR-V999D receiver is claimed to provide 150W of output power for each of the five main channels, while the KR-V888D offers 120W for each of the three front channels and 60W for each of the rear. Each receiver also offers Midnight Mode, which compresses the dynamic range of loud scenes to minimise volume variations for late-night viewing.

Both receivers also offer an on-screen GUI (graphical user interface), which is said to provide a new level of operating ease and convenience.

The KR-V999D and KR-V888D carry RRPs of $2499 and $1999 respectively. For further information circle 141 on the reader service coupon.

New high quality amplifiers for cars

Pioneer says its new GM-X802 Power Amplifier and its smaller siblings, the GM-X702 and GM-X602, combine precision Japanese design and American manufacturing know-how to achieve a new level of audio performance. All three are two-channel units which can be operated in bridge mode for higher single-channel output.

The GM-X802 offers low distortion Class A operation and produces over 200 watts max/channel or 600W in bridged (mono) mode. Other features include variable LPF crossover, variable bass boost and RCA output connectors.

The GM-X702 and GM-X602 produce 150W max/channel (400W bridged) and 100W x 2 (280W bridged) respectively, with both models featuring selectable LPF and HPF crossovers and variable bass boost. The selectable low and high pass crossovers mean the amplifiers can be configured for multi-speaker applications, with one amplifier for the bass driver and another for the mid and high frequency units.

All three models have a Total Harmonic Distortion (THD) of only 0.003% (10W/1kHz), while the GM-X802's signal to noise (S/N) ratio is 107dB, compared with 105dB for the GM-X702 and GM-X602.

The GM-X802 carries an RRP of $829, the GM-X702 an RRP of $569 and GM-X602 $469. They should be available at most Pioneer stockists, but for more information circle 144 on the reader service coupon.

Centre channel speaker from Sonique

Sonique's new SAV-C1 Centre Channel loudspeaker is part of this Australian company's SAV range of Home Theatre loudspeaker products. The Centre Channel speaker is in many ways crucial to the performance of a home theatre system, linking sound solidly to the picture, and also realistically reproducing sounds such as dialog.

Sonique says the SAV-C1 has been designed to provide accurate voice matching to all of the other SAV products, providing an almost seamless transition of sound around the room. It will also match very well with other quality main speakers, achieving the most realistic sounds from the latest technology including Dolby Pro-Logic, THX and Dolby Digital (AC3) systems.

The SAV-C1 incorporates new 'second generation' magnetic shielding, a feature that minimises possible adverse effects on the most sensitive TVs and video monitors. It is also compact, with soft edges and easy care textured black painted finish, and is supplied with rubber feet to protect furniture surfaces. Gold plated terminals give long term high performance and reliability.

The RRP of the SAV-C1 is $495, and it's available from selected hifi stores in all states. For more information contact Sonique Audio Sonique Audio at 14 Kindale Court, Pooraka 5095 or circle 146 on the reader service coupon.

New stereo TV from Panasonic

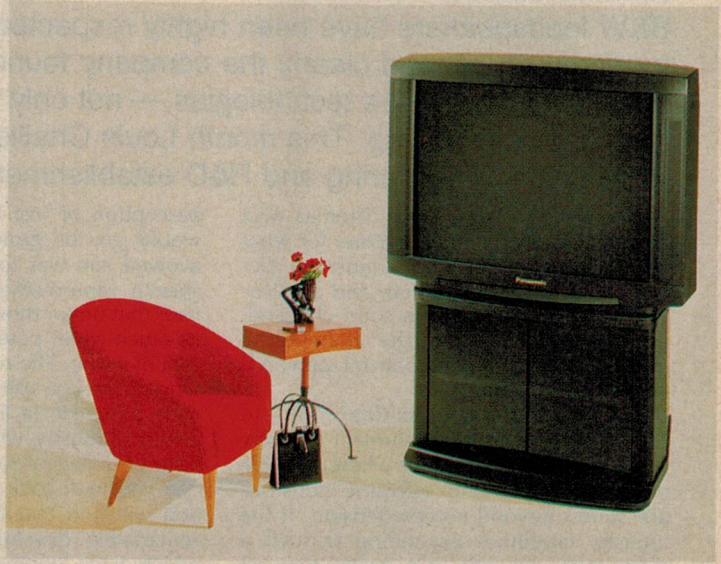
Panasonic has replaced its successful 'The One Up' 68cm stereo television with a new model called 'The New One Up'. The new model TC-68GS71A is produced in Australia at Panasonic's manufacturing plant in Penrith, on the outskirts of Sydney.

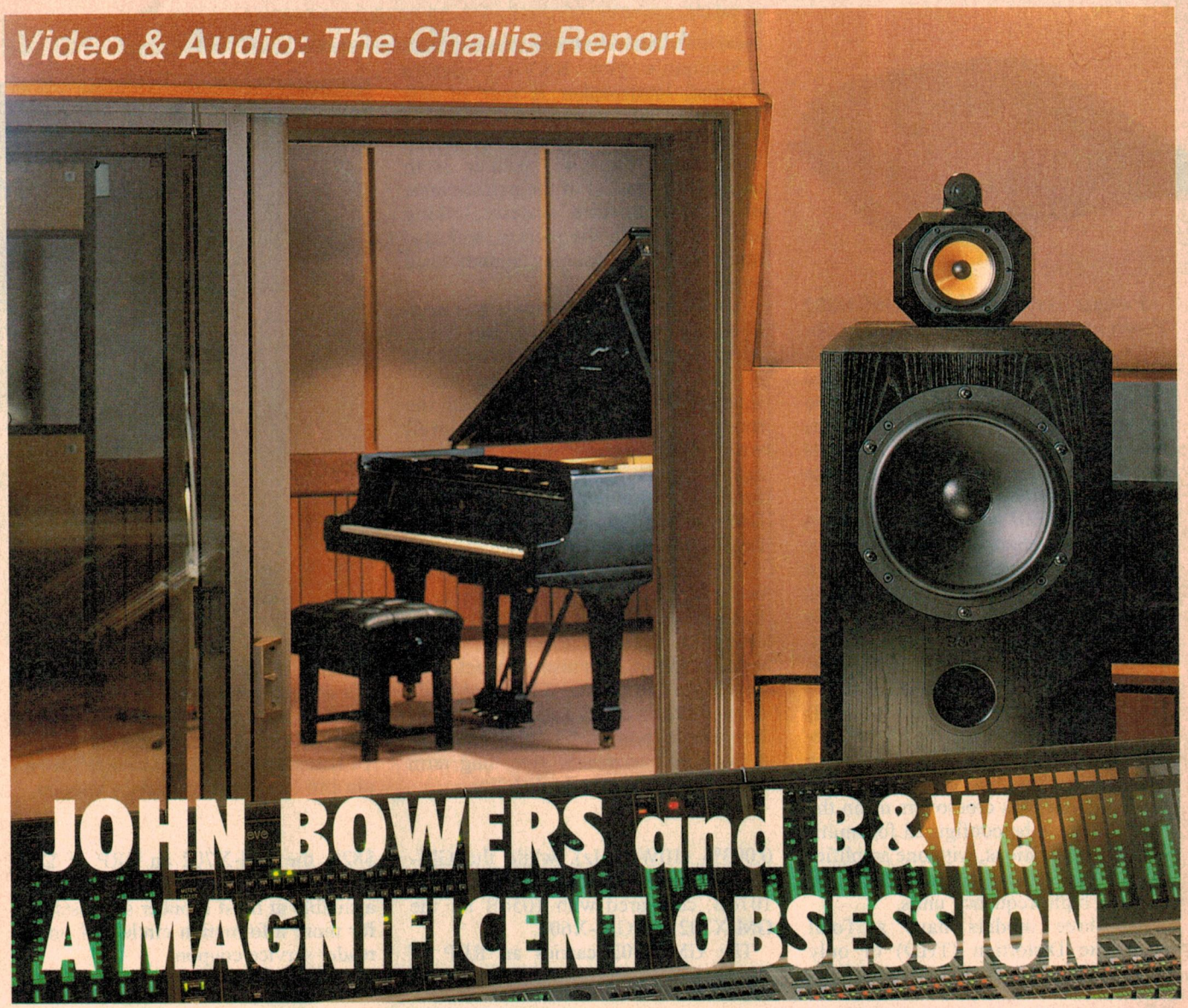
The TC-68GS71A has a super flat and black picture tube, giving it excellent picture quality with deep blacks and rich colours. The set boasts 'artificial intelligence', continually making minor adjustments to the picture to ensure ideal viewing quality. The picture menu provides three viewing levels to enable the viewing to select their personal preference.

Other features include stereo surround sound of 10 watts per channel, a 13W subwoofer incorporated into the back cover, and a sound menu to select between three pre-set sound levels: 'standard', 'music' and 'speech'.

With three AV inputs and one AV output, the TC-68GS71A can be used to display pictures from video cameras, video games machines, VCRs etc., as well as providing picture output for other televisions or monitors. The front connections allow quick and easy connections for non-permanent items such as video cameras and games machines.

As with all of Panasonic's Australian-produced televisions, the TC-68GS71A conforms to the Australian Standard AS3250 for electrical safety and has been approved through the Standards Australia T-Mark Type Tested Scheme. It is available from leading electrical retailers for an RRP of $2099. ❖





JOHN BOWERS and B&W: A MAGNIFICENT OBSESSION

B&W loudspeakers have been highly respected among high fidelity and sound recording people for some years, and clearly the company founded by John Bowers has been at the forefront in developing innovative technologies — not only for loudspeaker systems themselves, but also for their objective testing. This month Louis Challis reports on a visit he was able to make recently, to B&W's manufacturing and R&D establishments, in Britain.

It's now 120 years since Thomas Alva Edison laid the foundation stone for what was initially a niche market industry: dictation machines. The nature and application of Edison's invention soon changed, and within 20 years the dictaphone changed into a phonograph for universal home entertainment.

Over the last 100 years (from 1897 to 1997), that home entertainment industry has exploded to the point where the size of the hardware and software industries are almost beyond comprehension. If the industry continues expanding at such a giddy rate, no one can really forecast where it will ultimately end.

Now if you read Thomas Alva Edison's pronouncements on this subject, you will gain the impression that he had no real perception of just how far his invention would go, or grow. Whilst his primary avowed aim was to develop a system for speech reproduction, it was only much later that he (or those around him) realised its much wider potential for the reproduction of music. The rest of course, is history. During the last 100 years, what was originally a twinkle in Edison's eye has grown into an industry which garners many billions of dollars of revenue each year.

If you look back over that last century, you will find that there have been some remarkable developments in technology which have impinged on the quality of sound provided by home entertainment systems. Those systems have been purchased by billions of people, who have been progressively aware of both the quality and limitations in their systems.

Whilst Edison's earliest mechanical transducers (which were those replaceable one-shot needles attached to a mica diaphragm at the end of those beautiful big horns) may well have been criticised for their abject lack of fidelity, things have progressively improved since then. There are incomparable differences between an early Edison phonograph and the quality of sound produced by a modern hifi system. Of course, the really big steps were achieved with the development of valve amplifiers, and subsequently, of electrodynamic speakers. Of course they were developed 75 years ago, to fulfil the auditory requirements of those lucky and affluent people who could afford to purchase a wireless.

Each successive development in sound

reproduction came as a result of our insatiable quest for improved audible fidelity. Whilst we should acknowledge that the initial developments were rather slow in coming, the subsequent developments came thick and fast as more and more people put their shoulders to the wheel — and their hands in their pockets.

Transducers crucial

With very few exceptions, the ultimate quest of each inventor, researcher or engineer involved in the development of new or improved sound reproduction systems was to create a reproduced sound quality which would be almost indistinguishable from the original. The primary impediment limiting that achievement was imposed by the transducers at both the input and output of the sound reproduction system, rather than the amplifiers in the middle.

Ultimately the inherent and dramatic improvements in the quality of the input transducers, and associated amplifiers, has resulted in a situation where the loudspeakers have become the limiting factor in our quest for perfection.

Now, as good as modern loudspeakers may be — and it must be acknowledged that the best are now exceptionally good — they have still not reached the level of perfection where truly serious listeners are unable to differentiate, or discriminate between the original sound and the reproduced sound. There are of course dozens, if not hundreds of loudspeaker manufacturers who truly believe that they alone can solve the problem, and provide you with the perfection which you seek.

Every manufacturer to whom I have spoken aspires to produce a 'truly outstanding' loudspeaker. Not surprisingly, there are many men and quite a few women in the world who would have devoted a sizeable proportion of their lives, and in many cases, an equally large proportion of their financial resources (or that of their shareholders) to fulfil that complex quest.

A fundamental problem which initially plagued all loudspeaker manufacturers, and from which many still appear to suffer, was their lack of appropriate objective testing facilities and procedures. The aim of such testing was to effectively (and preferably objectively) quantify the differences between individual systems or changes in those systems, and correlate them with what we can hear.

Indeed, as little as two or three decades ago, the problem was so serious that many manufacturers discarded the concept of performing objective measurements in preference to hiring musicians or people who claimed to have 'golden ears' (or were purported to), to provide the critical comparative assessments. Fortuitously, a significant proportion of those remarkable people did turn out to have exceptional hearing. As a result, many of those manufacturer's heartfelt efforts were not entirely wasted.

There is, of course, one fundamental problem with producing loudspeakers whose design and/or subsequent performance requires a 'man or woman with golden ears'. The inevitable catch is that he or she may not necessarily be available to be used either at the time or location dictated by a specific requirement.

Objective testing

The obvious solution was to develop objective test methods which would allow us to measure all the relevant parameters, with hardware and the related software designed for that purpose.

Over the last 30-35 years, countless dedicated engineers and loudspeaker developers set out to do just that. Whilst there are hundreds if not thousands of people whose work in the field is worthy of mention, the people whom I consider to be the luminaries of their age can most probably be counted on the fingers of two hands.

Although you may have been unaware of the names of those people, two Australians, Neville Thiele and Richard Small, figured prominently in that list. They are now internationally famed and respected for their development of what have now become known as the 'Thiele/Small loudspeaker parameters'.

The next distinguished person in that list was an American, the late Dr Dick Heiser. I had the good fortune to meet Dick personally and spend a morning with him in a motel suite discussing his theories and his practical approach to loudspeaker analysis. His concepts were subsequently adopted as the basis for the T.E.F. commercial sound analysis system.

During the same period, two

B&W production engineers inserting a bass driver into the shell of a Nautilus system. The 300mm driver has a sand-cast chassis, a 9.5kg magnet and a 100mm voice coil. (Opposite page: a B&W 801 at the Abbey Road recording studios of EMI.)

Englishmen left their mark on the development of loudspeakers and are equally worthy of commendation. The first was Dr Laurie Fincham, the previous research director at KEF. His outstanding research work lead to the development of his time-decay spectrometer, and once again I was fortunate enough to be privy to his research work which he outlined during a meeting of Technical Committee TC29 of the International Electro-Technic Commission, which was held in Moscow in 1974. Once Laurie had shown us how the problems could be solved, it did not take long for I and many others to emulate his work to produce comparable speaker analysis systems.

John Bowers and B&W

The second person in the UK worthy of commendation was John Bowers, who founded the B&W Loudspeaker Company. John was one of those rare and outstanding people, who was motivated by what can be best described as 'a magnificent obsession'. The focal point of his aims and much of his effort was the development of the ultimate in consumer loudspeakers. He was convinced that he could develop and market a series of affordable loudspeakers which would be distinguished by their superiority and overall fidelity.

I came across my first pair of B&W speakers in the mid-70s, when I reviewed a pair of B&W DM70s for *ETI*. The DM70s were very good, and put B&W 'on the map'. John Bowers played a significant role in the development of those speakers, and in many subsequent developments at B&W until his untimely death in 1987.

Feldman to blame!

If I were to lay the blame for my recent trip to Worthing (UK) at anybody's feet, then I guess the most likely culprit would be the late Len Feldman. Len was an exceptional and endearing person, who at that time was the senior reviewer for *Audio* magazine. I first met Len in Japan in 1980. He convinced me that I must review B&W's recently released 801 series monitor loudspeakers. Following my return from Japan, I approached Convoy International, the B&W's Australian Agents, and requested a set of B&W 801 loudspeakers for review (See *ETI* January 1981).

The B&W 801 series loudspeakers were so impressive that a few months later I resolved that it was time that I set aside my Quad electrostatics, and purchased a pair of B&W 801s for use as reference speakers.

In the ensuing period, I have tested many different speakers, some of which were outstanding. But none of which outperformed the B&W 801Fs, and the subsequent improved B&W 801M series monitoring loudspeakers.

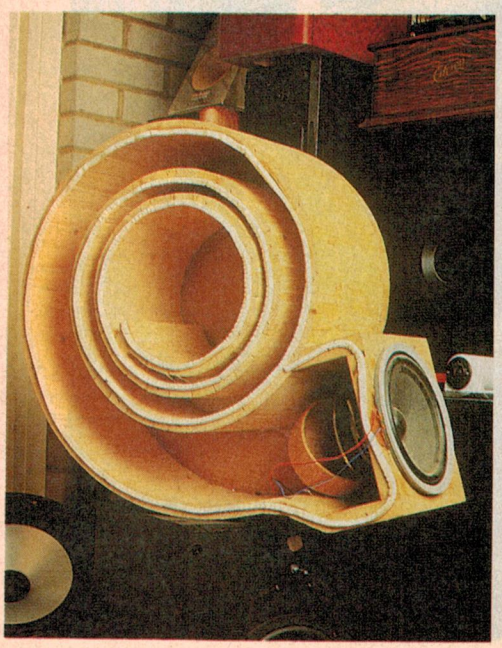
With hifi manufacturers on the other side of the world, there has been a tendency to treat Australians like mushrooms when it comes to disseminating information. The same rule appears to affect reviewers as much as it does other members of the public. It was only as a result of reading European and American magazines that I became aware that B&W had adopted and developed some unusual research and development tools — including an exciting laser interferometry system for assessing speaker diaphragm's modal responses. How they did it, what it showed, and more critically what they did with the data collected, was not explained.

Notwithstanding, it was clear that by using that specific tool, and other unstated techniques, B&W had made a breakthrough in developing superior loudspeakers. Their pioneering work in the adoption of time-aligned loudspeaker configurations was impressive, and it was not surprising that many of their competitors soon adopted those same principles and philosophy.

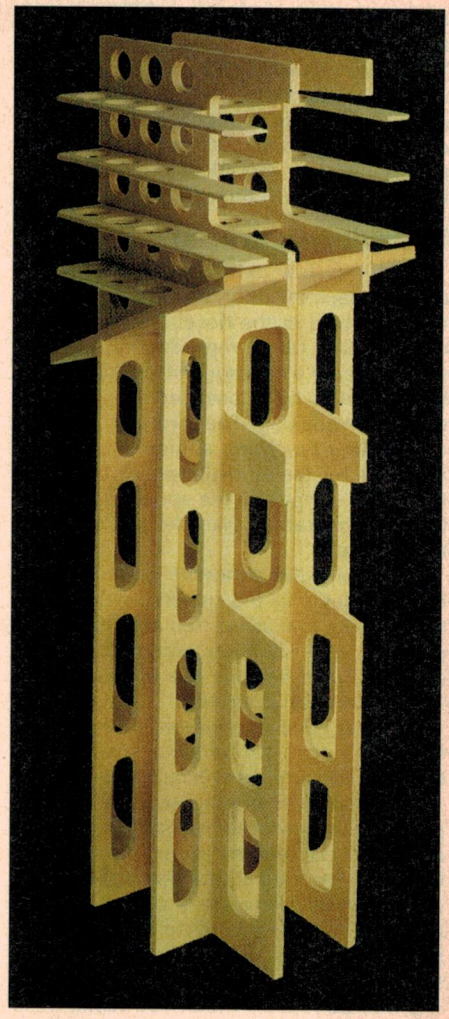
B&W's research philosophy directed them along a different path to virtually all of their competitors, and was based on a synergy of new technology, the interrelationship of theory with their practical measurements, and correlation of that data with subjective evaluations.

An examination of the B&W's top line speakers revealed that they had developed and were making most effective use of new materials, as typified by Kevlar, magnetic materials and even the flexible surrounds, to produce 'state of the art' speaker drivers.

It was obvious to the major American reviewers with whom I spoke, that B&W had achieved performance standards which were either equal to, if not head and shoulders above that of most of their competitor's products. What was not clear to them, nor to me, was why or how they had chosen their unusual path, and what speaker assessment procedures they had actually adopted.



An early coiled-duct prototype tested during the development of the Nautilus system. The coiled shape contributes to minimising resonances.



B&W's patented Matrix system, a structure used to create a three dimensional array of echo-free chambers inside a speaker cabinet. The cells are filled with acoustic damping material.

I was obviously just one of many people who were intrigued by the enigma of B&W's rise, almost like the proverbial Phoenix, from amongst the tin sheds of a small town somewhere in West Sussex. In less than 12 years they had become one of the most respected monitor loudspeaker manufacturers in the classical music world. That of course, warranted an explanation and ultimately further exploration.

I bided my time until the opportunity presented itself for me to travel to B&W in the English summer, to see for myself what made B&W 'tick'. The opportunity finally presented itself this year.

Company in transition

Our arrival at B&W Loudspeakers Ltd's factory at Worthing set the tone for what was to follow. We arrived at a building which had a most unimpressive external

appearance, whose internal structure was being gutted. It was clearly in the process of being rebuilt. There was a feeling of pandemonium in the entrance, with switchboards being moved, power distribution boards being re-positioned, and a row of what had previously been administrative or executive offices beyond.

Following our entrance we were met by Paul Stanforth, the dynamic managing director, who has been given the difficult task of picking up the pieces left over by John Bowers' untimely departure, together with an economic downturn which has decimated most of B&W's competition.

Paul Stanforth is impressive, and has attacked the multiple problems with the assistance of an extremely competent group of technical, manufacturing and marketing personnel. Paul personally led us on a tour of the factory, which is modern and efficient. Unlike most of their competitors in the UK (and quite a few other countries for that matter), B&W manufacture almost all of their drivers in-house.

As we toured through the different sections of the factory, we observed that the drivers embodied new materials which had been thoroughly researched and tested; new adhesives; new assembly procedures; and most critically, almost universal testing of those individual elements before they were assembled and retested again before packaging.

I took the opportunity to examine B&W's 'on the floor' computer controlled loudspeaker test facilities (of which there were a number), to evaluate just what they did and how they worked. I was invited to enter one of the small anechoic chambers, which I did. While inside, I requested that they initiate a test which they reluctantly did. I then emerged to examine the resultant frequency response on the display monitor. That response revealed multiple bumps and dips generated by my anomalous presence in the sound field.

That is what I would have expected, for that's precisely what happens in our anechoic room when a foreign and unwanted object, (i.e. a human) is placed in the vicinity of either the loudspeaker or the reference microphone during a calibration or response test. Satisfied that the testing procedure correctly identified anomalies, and that the critical word 'failed' had appeared on the display, I asked them to run the test again. The repeated frequency response was now smooth, and the word 'PASSED' appeared...

Our tour progressed to the section of the production line which produces the famed 'Nautilus' speakers, of which only one or two have apparently reached Australia.

I was impressed by the size and quality of finish of the Nautilus speakers. I was even more impressed by their weight and by the obviously dedicated care being applied by the staff involved in their assembly, and subsequent testing.

It was suggested that I explore the Nautilus design concepts during our visit to Steyning, after lunch. I immediately

B&W has patented its method of using Dupont Kevlar material in speaker cones. Originally developed for bullet-proof vests, the material helps minimise unwanted standing waves.

resolved to do so.

Whilst examining the Worthing factory's shipping department with its multitude of special protective systems, we inquired whether (and to what extent) staff were encouraged to buy the company's products. We were assured that they do encourage them to do so, as that is a practical way to further the staff's involvement in what the company is doing and achieving. Most staff members opt to purchase the company's premium products, and they know what the difference then means. We then observed that the factory had recently been enlarged, and that the production lines were making full use of the enlarged capacity.

On to Steyning

In the afternoon we travelled 12 miles to B&W's Steyning Research Establishment. The Research Establishment has been deliberately sited in a remote location, as that ensures an intentional limited degree of contact between production, marketing staff and the research staff. That separation appears to have been a deliberate decision by the company's management, as it ensures that the research staff are able to progress with their complex tasks with minimum external pressures.

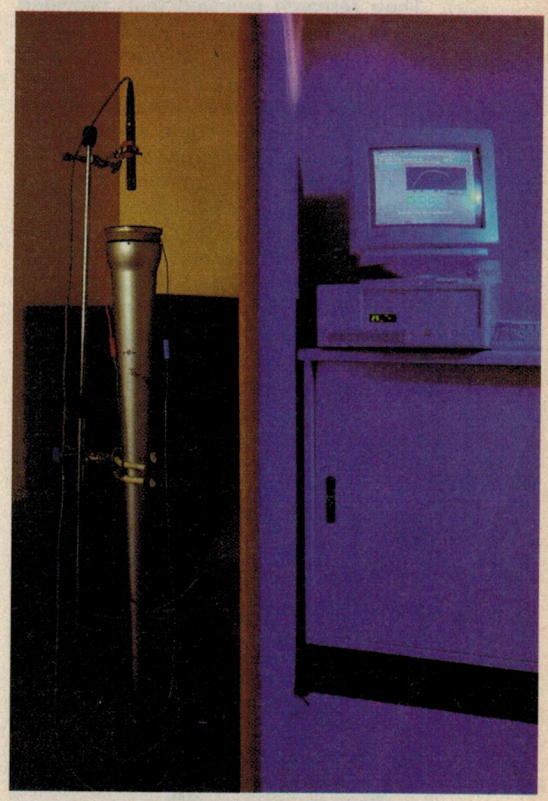
On entering the Steyning Research Establishment, I was immediately impressed by an obvious pervading aura. Each member of the research team, and each area within the building, conveyed an impression of creativity and technical competence.

I have previously visited loudspeaker research laboratories, including the large and impressive Matsushita Research complex in Osaka. Unlike the other Japanese companies which we had visited, the chief acoustical engineer had read my review on one of his products, and broke what is generally a rule in Japan, and took me into his 'inner sanctum'. As I then discovered the Matsushita facility, and most particularly its demonstration and listening rooms, had an almost clinical look and feel.

By contrast, the Steyning Research Establishment was considerably smaller, but my impression of the activities and personal involvement of each member of the staff was one of greater intensity, and unquestioned dedication. Each member of staff with whom we talked seemed to be motivated by that same 'magnificent obsession' which had driven John Bowers. That concept had obviously left its mark on each senior member of the current research staff.

The first thing I wanted to see was the laser interferometer, whose development I discovered was a joint effort between the National Physical Laboratories (NPL) and B&W around 20 years ago. It would appear that NPL developed the hardware, but B&W under the guidance of John Bowers saw how this brilliant tool could be put to work, to provide answers to enigmatic problems for which there had previously been no solution.

The problem which faced B&W and other speaker manufacturers was that loudspeaker voice coil/cone 'diaphragms' have what I would simply define as both a *linear* range of performance, and a *nonlinear* range of performance. Within that linear performance range, the diaphragm's motional excursion faithfully follows the electrical input signal. But when operating



A drive unit for the Nautilus system is tested midway through the manufacturing process. The test results are included in the report supplied with each system.

outside that range, the diaphragm's motion becomes nonlinear. That nonlinear motion is the primary source of higher order harmonics — i.e., distortion. The second factor is the reflection of vibrational waves from the edge of the flexible diaphragm, which then gives rise to standing waves in the speaker diaphragm.

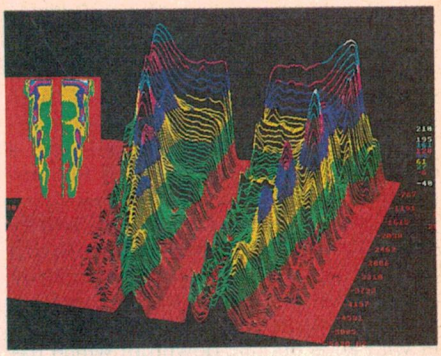
The problem is that the motion of the diaphragm invariably becomes distorted, and the cone starts to generate standing waves which are readily identifiable with a laser interferometer.

Whilst the vast majority of speaker manufacturers have taken the view that such problems should be avoided, at the same time their response to the issue has generally been a simple case of 'stiff cheddar'. John Bowers however, took an entirely different stance. His attitude, and that of the other members of his research team, was that this was a fundamental problem which had to be addressed, and could be satisfactorily resolved.

Their measurements revealed that most dynamic loudspeaker drivers had a tendency to generate standing waves. The type of flexible edge termination, choice of diaphragm material and method of connection of the voice coil to that diaphragm, provided ways and means of reducing the magnitude of the standing waves.

Their research revealed that, provided each of the sub-elements were optimally selected to match the limited frequency range over which the driver would reproduce either undistorted, or minimally distorted signals, then people with 'golden ears' could readily identify and discriminate the differences in performance. They progressed further into analysing the edge diffraction effects imposed on the speaker as a result of the presence and shape of the low frequency driver's cabinet, or even by the tweeter's separate enclosure.

They evaluated and identified the magnitude of the problem created by the speaker enclosure's self-generated resonances, and what effect that has on the resulting sound quality. They discovered that by controlling the resonance by the use of esoteric materials, such as fibrecrete for mid-range drivers and tweeter enclosures, they could minimise that effect. Their research was then extended to control the problem of the low frequency driver cabinet resonance, and that resulted in the development of the Matrix concept.



Laser scans comparing the performance of a Nautilus driver (left) with a typical plastic cone driver. Note the smooth behaviour of the Nautilus driver (unbroken bands of colour along the side), compared with the peaks and troughs of the plastic cone.

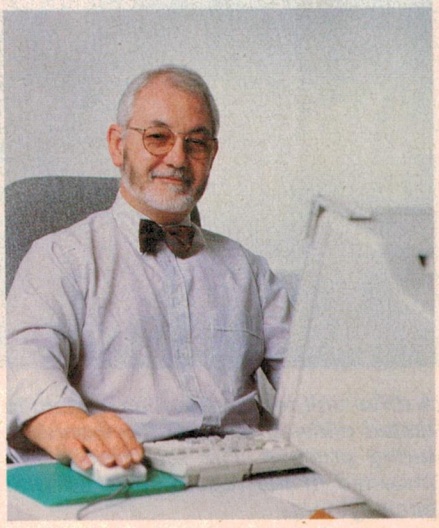
B&W's research showed that if the speaker cabinet were internally braced by a series of asymmetric tri-directional bracing elements, supplemented by absorptive media, then internal standing waves, external cabinet resonance, and unwanted re-radiation of spurious signals could be significantly, if not dramatically reduced. These concepts amongst many others, were then integrated into their B&W 801M series, and other 800 series of loudspeakers.

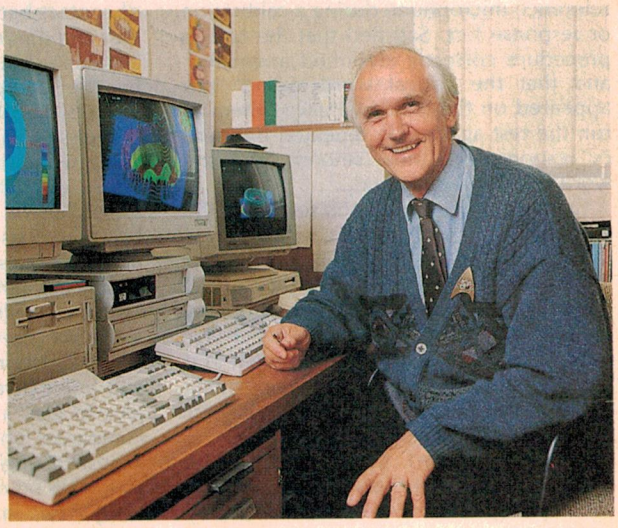
But they didn't stop there. They experimented with other concepts, and particularly the development of a true monopole speaker concept. Whilst some loudspeaker manufacturers, and particularly those manufacturing electrostatic speakers will claim that a dipole speaker is superior, that theory simply doesn't hold water.

The problem was, how can you make a device which is basically a dipole source (such as a conventional dynamic loudspeaker) behave like a monopole source which emits negligible sound from its rear, or from the enclosure in which it is located?

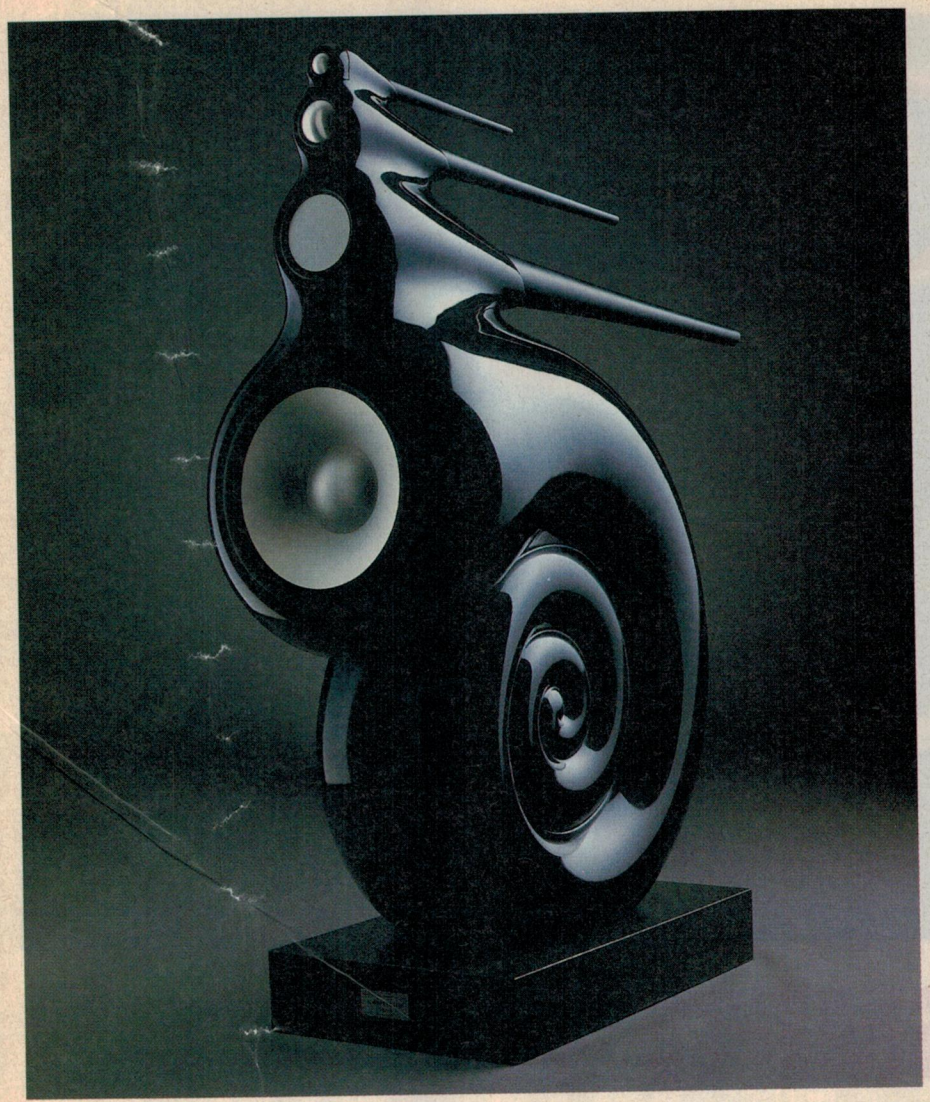
Dr Peter Fryer, the head of B&W's research team, and the other members of the team have developed an ingenious concept based on the use of a reverse-tapered horn whose inner surfaces are absorptive, and whose functional internal length ensures that there is negligible energy emitted from the rear. This concept was initially developed for the fabulous and expensive Nautilus loudspeaker, which epitomises all the cost and complexity of John Bowers' original 'magnificent obsession'. Fortuitously, the concepts developed in the Nautilus development program are now being adopted for the more affordable speakers that B&W are developing, and the first of those speakers are about to enter the marketplace.

Whilst at the Research Establishment, I examined their prototype fabrication workshop, which incorporates all of the tools that are required in the production areas of the main factory, but which are deliberately (and sensibly) isolated from that factory. The numerically controlled (NC) manufacturing equipment that they

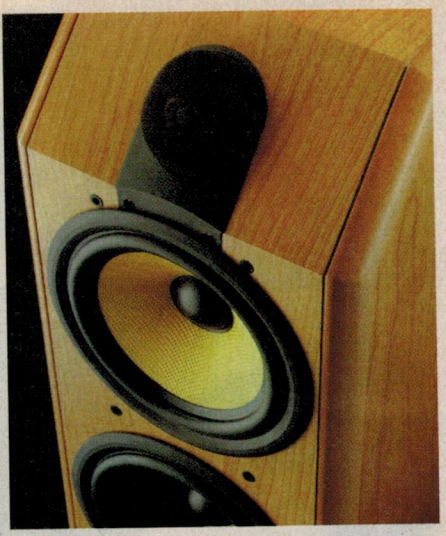




Two key members of B&W's research team: engineer John Dibb (L) and Dr Peter Fryer (R), who heads the laboratory. Louis was impressed by their passion and dedication — continuing the work of company founder John Bowers.



B&W's revolutionary Nautilus system, a hand made state of the art design which reviewers have described as 'the best loudspeaker that money can buy'.



Two views of the new CDM7 system, flagship of B&W's new Compact Digital Monitor series. In an audition at their R&D lab, Louis found their performance 'truly outstanding'.

use in the development of their new products is 'state of the art', and obviously has to be, to ensure that they can initially produce, and more significantly reproduce them when required.

After discussions with other senior research staff, and seeing at first-hand how they work, and more importantly what they are currently doing, I gained an impression of a dedicated team of researchers, who not only like what they are doing, but are all imbued with the same passion.

Listening session

As the finale to our visit, John Dibb took us into B&W's listening suite, where we spent the last 45 minutes of our stay. Whilst their, he gave us the opportunity to audition the latest CDM (Compact Digital Monitor) Series of B&W loudspeakers.

We spent most of that time putting a pair of CDM7 loudspeakers through their paces, and we soon discovered that their performance is truly outstanding. Their ability to reproduce a full sound spectrum was so impressive that I resolved on the spot that these speakers simply must be reviewed at the first opportunity.

Following my return, Convoy International provided me with a pair of CDM1s — B&W's initial release in the series. I spent half the weekend auditioning the CDM1s, and had difficulty in reconciling their low frequency performance with their size. Their broadband performance was remarkably good.

I noted that their low frequency performance is not on par with the CDM7s, which have at least another 25-30Hz of effective low frequency bandwidth. However the midrange and top end are truly comparable, and whilst monitoring the latest of Slave Grigoryan's discs 'Dance of the Angel' (Sony Classical SK63011), I came to the conclusion that in a small apartment, small monitor speakers like the CMD1s, or somewhat larger speakers like the CDM7s can revitalise, if not revolutionise your auditory pleasures.

John Bowers may be dead, but his spirit lives on. His 'magnificent obsession' has now been transmuted into the living. I observed it hard at work, both at B&W's factory and at its research establishment at Steyning. ❖

SYDNEY SMPTE 97 CONVENTION & SHOW

The old tussle between film and tape is now widening, with digital techniques and storage methods now clearly in the ascent. Although subdued, Sydney's SMPTE 97 Convention and Show managed to reassert itself, in spite of stiff competition from Asian broadcast expos.

by BARRIE SMITH

The production of motion pictures and television programming is increasingly adopting digital technology. Producers will still be making pictures with motion — but it appears the motion will, on most occasions, be captured, manipulated and stored as digital data. This became clear at the 1997 SMPTE event in Sydney, the 'show' part of which was held in two Darling Harbor exhibition halls, while simultaneously a series of technical papers was delivered at an auditorium in the city.

The video component of the show held few surprises, aside from the appearance, for the first time outside Europe, of JVC's S-Digital tape format in PAL — plus abundant hardware exhibited by both Sony and Panasonic in their versions of the professional digital DVCAM/DVCPRO format. Fading to near invisibility, on the Sony stand, were the Digital Betacam or SX formats. It would appear the 'smart money' is on the DV 6.35mm tape configuration.

It was near impossible to walk five paces without a PC, a computer peripheral or a software demo popping out at you. And evident was the 'flow down' of much high-end software, from Silicon Graphics platforms to Windows and NT compatibility levels.

And there were some exciting items on the most unprepossessing stands. But you had to hunt them out...

Free and steady

Until now, vibration-free helicopter shooting of film and video has relied on Tyler mounts and the Wescam system. First seen in this part of the world at Sydney's SMPTE was US company Flir Systems' Ultra 4000 stabilised camera system.

Arising from the Gulf War, the spher-

ical housing of the Ultra 4000 can accommodate a three-chip broadcast camera head and lens (the record unit is sited externally) and can produce vibration free pictures even with the zoom at full stretch. In the housing was a Sony BVP-T70 camera hooked to a 36X Fujinon lens with doubler — even at 72X the image was rock steady.

The unit uses a three-axis gyro stabilised camera system. Already 45 units are currently being used by US news and surveillance operators, and it looks likely to become popular with broadcasters in Australia for the upcoming America's Cup (in New Zealand) and the 2000 Sydney Olympics. The likely price in our region is around $500,000. Coming soon is a unit for a 35mm film camera.

Flir Systems' Ultra 4000 stabilised camera system for applications such as helicopter shots. It uses a gyro-stabilised platform.

Aerial chocolate

Like the Flir unit, the Wescam system depends on an externally mounted sphere. Tony Fitzsimmons of Aerial Camera Systems explained to this writer that a small Wescam 24 is here on a two-year stint, installed inside (on the side of?) the Whitmans chocolate airship currently doing a tour around Australia.

Sydney is currently under its flight path, while other capital city residents will soon enjoy the airborne sight of a chocolate promotion on an internally lit airship — equipped with a Wescam unit and TV camera. The deal is that the aerial chocolate bar hovers over sporting events, offering broadcasters an aerial feed in exchange for an external 10-second shot of the blimp in each broadcast hour.

Soon to be released by the company is a system accepting a film or video camera in a gyro stabilised ball, capable of performing a 45° Dutch tilt — so no matter what your aircraft is doing you'll always maintain horizon...

Canadian beer

It was a surprise to see demonstrations of Digital Processing Systems' Digital Fusion software. The surprise was because Steve Roberts, the author of the program, is an Australian now resident in Canada.

As Roberts said, Digital Fusion derived from a film project which needed special software and there were just "no other tools around to do it — so we invented the software as an in-house production tool". He has done a partnership with DPS and the application is now being used "on feature films in Hollywood: *Independence Day*, *Godzilla* and *Titanic* as well as (TV series) *Poltergeist* and *X-Files*". In Roberts' eyes the program is equivalent to Flame but runs on Windows NT. Roberts sees the Windows compatibility as a huge advantage in marketing the software.

It would appear Australian software developers have created some major landmarks in the motion imaging business. Some of the most popular and powerful software tools in the film industry — Inferno and Flame — were developed by Australian Gary Tragaskis. Similarly, the Cineon digital film software was largely written by Australians at Kodak's Melbourne facility.

Roberts acknowledges there are now quite a few Australians in the US and Canada, admitting the real reason for this preponderance is Canada's fine beer and its resemblance to our local drop!

Nary a Mac

While Windows machines proliferated at the show — a sure sign that high end CGI (computer graphics/imaging) software is rapidly migrating to this operating system, there were also signs that the Mac is being deserted by non-linear editing packages such as Media 100.

The Australian representatives for Media 100 are also now busy installing Transoft's StudioBOSS FC Fibre Channel Network option into two Sydney TV post production houses.

StudioBOSS FC is capable of transferring huge data files at 200MB/sec — fast enough for broadcast signals to be accessed by multiple work stations from a central server. The system is also cross platform — PCI-based Mac, SGI and Windows NT.

Digital Fusion high end software was authored by Australian Steve Roberts, now resident in Canada.

Visiting CEO Mike Klein explained the cost and time benefits are currently being enjoyed by such Stateside operators as NBC, ABC, CBS, FOX, Disney, Pixar, Universal and MGM.

Visiting fireman

In town from Hong Kong was Tektronix's Peter Martin as the new Tek Profile PDR200 hard disk video recorder went public for the first time in Australia. The two/four channel unit offers increased storage with higher internal bandwidth and digital audio. The new unit can hold nine hours of native storage and includes time delay, store and forward, spot and program replay as well as act as a cache for current CART machines — previously tasks for analog tape machines.

Tektronix also demonstrated some new releases from Grass Valley and Lightworks, respectively makers of film/TV industry switching and editing hardware.

Lightworks is a real time non-linear editing system based upon hard drive technology with the Lightworks editing interface. Also shown was the new Heavyworks version 6 software. The latter system was used to edit the movies *Shine* and *Romeo & Juliet*.

In view of the fragility of SMPTE and Sydney's position in the Asian expo scene, Peter Martin admitted there were "a lot of new exhibitions being planned that are trying to take the market share away from SMPTE". Asia Broadcast is pencilled in for November in Hong Kong, which may have some geographic problems in drawing the customers that SMPTE or Broadcast Asia would attract, because of the timing after IBC and Broadcast India, and the big TV show in Beijing at the end of August.

Ongoing commitment

Rejoicing was GEC-Panasonic's Stuart Poynton, as he announced on SMPTE Day One that a full, ongoing committment to Panasonic DVCPRO hardware and systems has been given by Olympics host broadcaster Seven Network.

Said Poynton: "They (Seven) will have the world's first complete digital acquisition, to digital editing, to digital server, to on-air system. The whole environment of their news editing operation, from acquisition to editing will all be in DVCPRO."

On the GEC-Panasonic stand was the small desktop DVCPRO VTR AJ-D230, an AJ-D650 full function editing VTR for non linear systems, as well as an AJ-D750 — a full studio DVCPRO VTR. Beside it was the QuickCutter, a new non-linear editing system relying on a high speed integral VTR.

From this it would seem that the tiny 6.35mm tape format is being pitted against hard drive systems in many areas of television broadcasting.

Tektronix's new hard disk video recorder went public for the first time in Australia, offering nine hours of programme storage.

DV to the fore

Sony's impressive two-tier stand housed a whole floor of DVCAM products, from production cameras to non-linear editing systems and a suite showing rapid dubbing between the DSR85 high speed 4X machines.

The cameras ranged from the tiny DSR-PD1, a single chip, pro equivalent of the consumer PC7 — but in DVCAM format — to the DSR200 three-chip model 1/3" CCD.

Sony's Ian Lowe explained that "in the consumer market place DV is doing quite slowly, but is doing very well in the pro market" — adding that Sony now have "around 160 DVCAM units in Australia, mainly cameras plus a few VTRs, DSR30 recorder/players". By comparison, only 600 consumer DV camcorders have been sold, with a large proportion going to the pro market place.

Will it, or won't it?

There was much conjecture by show delegates as to JVC's S-Digital stance in the local market.

JVC agent HCL's Nick Fitzgerald demonstrated the JVC BR-D40 dockable recorder in PAL. He was convinced — and no doubt would attempt to convince his customers — that the format's 4:2:2 signal would offer unique advantages amongst the other mini digital formats, revolving around such tasks as

GEC- Panasonic's Stewart Poynton announced that Panasonic's DVCPRO format had been taken up by Channel Seven.

"keying, where you don't get the colour fringing artefacts associated with the other formats". Fitzgerald was of the opinion that some will head for Sony's Betacam SX digital format, which uses MPEG2 compression, but did not believe it is "really the answer that the broadcasters are looking for; Digital-S is the one that really gives you quality at an affordable price". Its most likely deployment in this part of the world is as a replay system in Pay TV head ends — as per the example of operator Australis' S-VHS for its Chinese and Italian channels.

Obviously having a bet each way, JVC also showed the BRD10 DV dockable recorder — for PAL at 4:2:0 — and the only dockable DV recorder on the market. Camcorders will be released in the middle of 1998.

Jean-Francois Bouzanquet from Balcar France showed a new focusable fluorescent lighting system.

Soft no longer

Fluorescent lighting has taken firm hold in the Australian broadcast and production environment. On the Miller products stand, Jean-Francois Bouzanquet from Balcar France showed a new focusable fluoro system. This unit now completes the range that originally started with the Fluxlite six lamp, now installed in around 20-30 TV stations and production houses in Australia.

Traditionally, production people associated fluoros with 'soft' light. Now a focusable fixture can complement the soft, even shadowless light of traditional fluoros.

Up light

The formerly British-owned Samuelson group, now owned by Panavision Corp, went one further in the lighting department by helping local company Lunar Productions publicise the French innovation Balloon of Light.

The balloon is helium filled and houses an internal 16kW HMI lamp. It has been used on *Mission Impossible*, *Titanic* and *Rough Rider* as well as *The Ripper* and *Murder Call* in Australia.

In terms of output the Solar 500, equipped with 16kW of HMI, can provide 2.5-3ft/candle readings over an area of 230 feet from a height of 160 feet. One drawback is that, once filled with helium, the balloon's gas content cannot at present be retrieved and reused. The Sydney company is searching for a solution that could mollify the burden of a thousand dollars or so of gas heading wastefully skywards, when the balloon is brought down.

An overall view of the SMPTE 97 exhibition area in Sydney's Darling Harbour Convention Centre.

Heavy talk

Whilst much of the exhibition was glitter and marketing at its most persuasive, food for the technical mind was freely available over at the conference hall, a monorail skip away.

One discussion which drew curious spectators was Digitally Effected Cinematography, presenting the views of cameramen Paul Murphy (*Bliss*), Andrew Lesnie (*Babe*) and CGI 'heavies' Dale Duguid, Peter Doyle (*Dark City*) and Peter Webb (*Romeo & Juliet*).

There is some vivid discussion ongoing in cinematography circles as to the awarding of credits (and gongs!) for cinematic magic — traditionally the sole creation of the DOP — often now (and invisibly) metamorphosed by CGI people. The former were encouraged to accept the computer in the photographic process, while the latter were obviously busy picking up and emulating every trick the camera can achieve. This one won't go away!

Other and more intricate subjects were covered in presented papers, including: standards in the next millennium; switching and routing in a congested analog/digital environment; aspects of video quality in MPEG-2 compression systems; and a natural co-paper — compression: when to be

(Continued on page 46)

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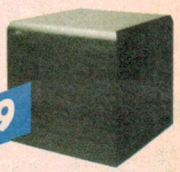

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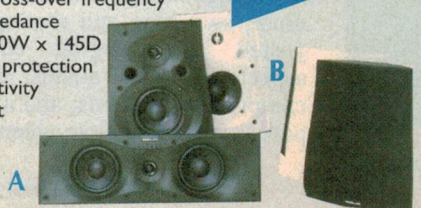

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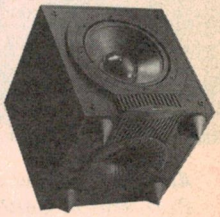

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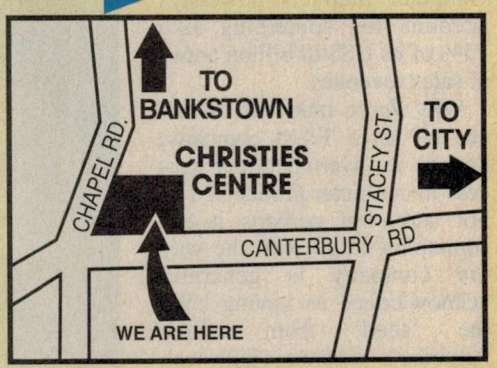

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THE HP WAY: A DISCOVERY TOUR

A few weeks ago, EA's editor was able to visit some of the Hewlett-Packard Test & Measurement Division facilities in the USA. The main purpose of his trip was to see some of HP's popular test instruments being made, and to meet the people responsible for their design and manufacture. However it also provided an opportunity to learn a little about the 'HP Way', which is generally credited with underpinning the company's ongoing stability and success, despite enormous growth over its 58-year history.

by JIM ROWE

Mention the name Hewlett-Packard to most people nowadays, and they'll immediately think of high quality laser printers, inkjets, desktop scanners and personal computers. Yet to many of us who've been in electronics for a while, the name evokes quite a few additional images — of equally high quality signal generators, analysers, counters, oscilloscopes, power meters and cesium-beam atomic clocks.

In fact to many electronics people, Hewlett-Packard has *always* been essentially a maker of leading-edge test and measuring instruments. The fact that this T&M company 'grew' some additional divisions, which happen to make a lot of innovative and very successful computer products, hasn't really changed this perception — even though HP's computer products nowadays account for something like 75% of its US$40 billion annual sales revenues.

Why *do* so many of us still see HP as a T&M company, despite its overwhelming success in computer products? I'm not sure, but perhaps it has something to do with the way the company is generally acknowledged as having been the 'seed' from which America's dynamic high-tech electronics industry blossomed in the Silicon Valley area just south of San Francisco in California. In fact eight years ago the Palo Alto garage where Bill Hewlett and Dave Packard started making their test instruments back in 1939, at the rear of 367 Addison Avenue, was proclaimed a California state historical landmark: the 'birthplace of Silicon Valley'.

HP founders Dave Packard (L) and Bill Hewlett, pictured in 1989 outside the Palo Alto garage where they began making test instruments. Acknowledged as the 'birthplace of Silicon Valley', the garage is now a California state historical landmark.

Quite apart from this historical significance, it's also the original T&M part of HP which is widely recognised as having pioneered and developed many of the key principles of managing successful hi-tech manufacturing and business. For example the company was the first to adopt the principles of decentralisation and management by objective, and it virtually invented MBWA or 'management by walking around'. In addition it has always had a literal 'open door' policy, with everyone working in open-plan, doorless office areas — including the CEO!

Speaking for myself, I guess I've had a special regard for HP ever since I discovered that founders Bill and Dave were students of and friends with the famous Stanford University professor Fred Terman, whose textbooks *Electronic & Radio Engineering* and *Radio Engineers' Handbook* were invaluable references for numerous engineering students of my generation around the world. And that regard has only grown stronger over the years, as I've had the opportunity to try out and review many of HP's new instruments when they've been released on the market.

So when HP's T&M Operation recently extended the invitation to visit some of their US facilities, I jumped at the chance. It sounded like a great opportunity to see some of their instruments being

made, meet the people behind them, and also perhaps get a better feel for what makes this impressive company 'tick'. And that's exactly what it turned out to be...

At Santa Rosa

The first facility I visited was at Santa Rosa, California, about 75km north of San Francisco in the winegrowing area of Sonoma County. Here I was first hosted by Marcom specialist Susan Fisher, who made sure I met many of the people in the Microwave Instrument Division (MID), which designs and manufactures RF spectrum and network/component analysers, RF and microwave signal generators, noise and power meters, and broadband/cable TV test instruments.

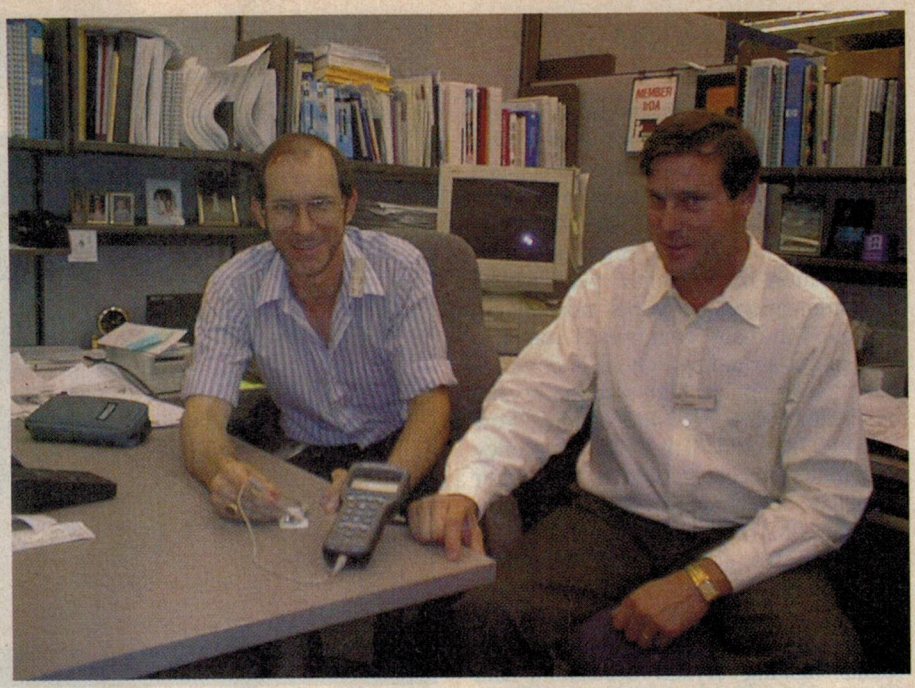
Lynne Stewart gave me a presentation on HP's signal generator and analyser range, and then Renee Cherolis demonstrated the new ESG modular RF signal generator models. Very impressive!

Next engineer Nadine Brown gave me a hands-on demo of the impressive new HP 8720D Microwave-Vector Network Analyser, which can be used to analyse the behaviour of components and circuits between 50MHz and 20GHz. This is a very powerful instrument, which allows the microwave behaviour of components to be analysed in surprising detail, and with an impressive level of confidence. Even the connector systems and calibration tools for this kind of instrument are impressive, as they must be manufactured to mind-boggling tolerances.

R&D engineer Frank David then gave me some insights into the development of the 8720D, and also explained how YAG (yttrium aluminium garnet) crystal sphere resonators are used in the microwave oscillators for this and similar instruments.

Soon after I was also able to try out the HP 89441A Vector Signal Analyser, which can provide detailed and accurate analysis of signals up to 2.65GHz, with almost any kind of complex digital or analog modulation. One of the things that impressed me most about this instrument was the wide range of display options it provides, to allow fast interpretation of the measurement data.

Marcom technical specialist Frances Keana then introduced me to some of the people in the Santa Rosa Systems Division (SRSD), which essentially seems to develop fully integrated 'test solution' systems for specific market needs, based on or around existing HP instruments. Matthew Newlands gave me a demonstration of an integrated testing system SRSD has developed for EMC spectrum monitoring, for example, and I heard about some of the work being done in developing testing and measurement solutions for the automotive industry.



Proud parents: Eric Vogel (L) and Von Campbell, R&D project manager and business team manager respectively for HP's new LogicDart — the low cost, multifunction 'personal digital troubleshooter'

My next call was at the Lightwave Division (LWD), where Marcom specialist Bob Matsuba explained the role HP is playing in developing test systems for the burgeoning fibre-optic communications industry. He also took me around to meet some of the people developing the systems, and showed me some of the latest optical test instruments.

Then I met Karl Kachigan, product marketing manager for HP's EEsof Division. Karl gave me a comprehensive overview of EEsof's integrated suite of powerful software tools for circuit and component analysis and design. After this he hooked us up for a video conference with the main EEsof headquarters in Westlake Village, southern California, and I was able to ask questions of software engineer Carter Smith and Marcom specialist Elizabeth Kannow. Where would we be, nowadays, without the internet?

To Santa Clara...

But then it was time to move on, and a few hours later I found myself in HP's Santa Clara Division, in the middle of Silicon Valley. Here I was greeted by senior PR manager John McCreadie, who introduced me to marketing managers Marc Saunders and Mike Cunningham, and also organised a telephone conference with Byron Anderson, VP and overall general manager of the Microwave and Communications Division (which includes the Santa Rosa divisions I had just visited). Mr Anderson was in fact driving up to Santa Rosa himself at the time, for an urgent meeting, but we were able to have quite an informative discussion.

Next day I was able to spend some time with John Minck, a long-time HP employee who has officially retired, but explained that he "just can't stay away". Currently John provides US representation and support for HP's Kobe Instrument Division (KID) in Japan, which makes the company's digital impedance measuring instruments (like the HP 4263A LCR Meter I reviewed in June 1992). John gave me a presentation on some of KID's latest instruments, including the HP E4915A/E4916A Crystal Impedance Meters and the HP 4352S VCO/PLL Signal Test System for testing voltage-controlled oscillators and phase-locked loops. He also told me about his 'sideline' editing the *NCSL Newsletter*, a quarterly magazine published by the National Conference of Standards Laboratories. Judging by a sample copy he gave me, that's quite a sideline!

While I was at the Santa Clara facility, Marcom specialist Jerrie Kerins took me to meet some of the people in the Timing Solutions area, responsible for HP's high stability crystal oscillators, their world famous cesium-beam 'atomic clock' time and frequency standards,

and their new GPS-derived time and frequency reference receivers. Here I was able to meet business manager Rex Chappell and his colleagues, and get a good idea of the way HP's products are being used to establish timing and synchronisation for the high speed digital communications networks now being deployed in many countries. I was also able to get a rundown on HP's compact new 'hockey puck' high stability crystal oscillator design, and their new HP58503A GPS Time & Frequency Reference Receiver, which uses their SmartClock technology to deliver ultra-precise 10MHz and 1Hz signals.

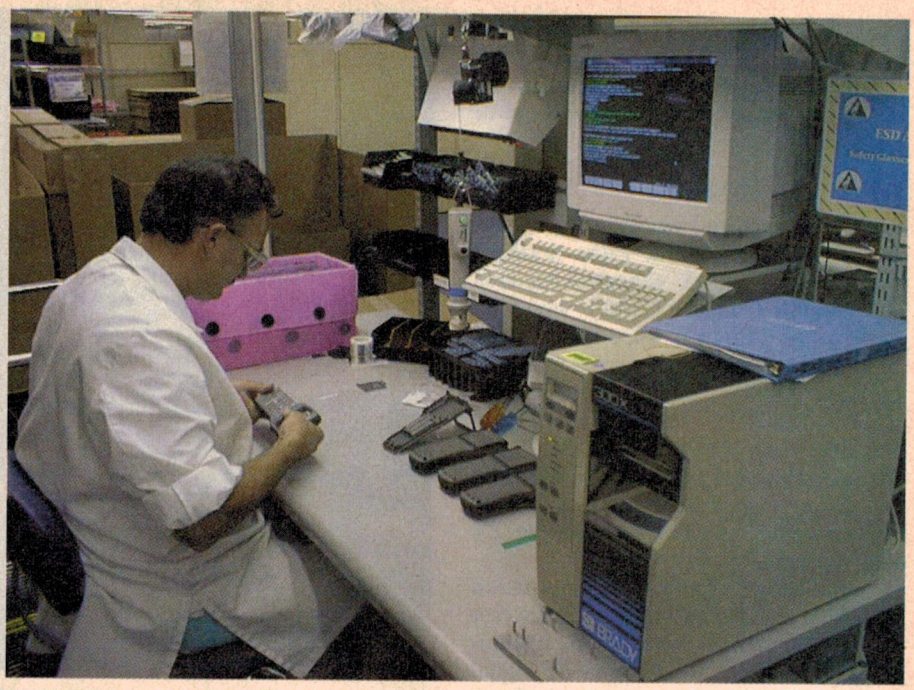
I was also able to meet engineer Chuck Little, who has worked at HP's Santa Clara Division for many years. Chuck took me on a tour of the departments making crystal oscillators and cesium-beam clocks, and I was able to see for myself the huge expertise that HP has built up in these specialised areas. No wonder over 78% of the ensemble of atomic clocks used around the world to establish the UTC global time standard consist of HP's 5061A/B and 5071A models!

...and then Loveland

My time at Santa Clara having drawn to a close, I was soon on a plane to Denver in Colorado, and then on a bus to Loveland (about 70km north of Denver), where HP's Electronic Measurements Division (EMD) is based. This is the division which produces the attractively priced 54600-series of oscilloscopes and logic analysers, and also the new LogicDart 'personal digital troubleshooter' which I reviewed in the August issue.

Early next morning I was picked up by PR manager Bill Van Eron, who took me to meet Mike Gasparian — the dynamic general manager of EMD, credited with being the driving force behind the impressive achievements of this division in recent years. It was great to be greeted by Mike and his team almost as an old friend, and to discover that they were well aware of reviews that EA has given their instruments. Some of our reviews have even been reprinted and used as part of EMD's marketing program, I learned.

Next I met Barry Scott, who gave me a most impressive hands-on demonstration of the new HP 34970A Data Acquisition System. Known in-house by the nickname 'Alfalfa', this has been expressly developed as a portable, low cost data acquisition system for R&D, production and site maintenance. It looks rather like the HP 34401A 6-1/2 digit DMM I reviewed in January 1992, and in fact actually includes the 'guts' of the 34401A inside. However the EMD team has been able to compress the DMM circuitry — together with a dedicated DAQ microcontroller — into around half of the original case volume, leaving space for a three-slot card cage accessed from the rear. They've also developed a range of eight matching switching and control modules, which plug into the instrument to give it a high degree of flexibility and make it suitable for a wide range of DAQ applications.



LogicDart manufacturing team member Ron Pickles at the final assembly/test station in the Loveland facility. The LogicDart is designed for very efficient manufacture.

All this from a basic instrument costing only A$1869 (ex tax), with the modules ranging from A$428 to $717. I hope we can review one of these systems in *EA* shortly.

After this I met Von Campbell and Eric Vogel, who are respectively business team manager and R&D project manager of the team which produced the new LogicDart. Having checked and reviewed this instrument only a few weeks earlier (and been very impressed), I found it especially rewarding to meet the people responsible for its design and manufacture, and hear how much effort they'd all put into it.

Eric Vogel then took me to meet Jochen Grauer the LogicDart production engineer/manufacturing team leader, who showed me through the manufacturing area so I could see all of the steps involved in making a LogicDart. It became very clear that a huge amount of planning has gone into this project, to ensure that traditional HP quality hasn't been sacrificed even for this budget-priced instrument. The units are all tested after each stage of manufacture/assembly, and even the final packaging is monitored using a barcode scanning procedure.

I spent about 10 minutes watching manufacturing team members Ron Pickles and Gwen Ekhoff performing the final assembly/test and packaging operations respectively, and in this short time they turned out an impressive number of finished LogicDarts.

That afternoon Bill Van Eron drove me down to HP's Colorado Springs facility, about 100km south of Denver, where I was to meet the 'other half' of the EMD team. It's in Colorado Springs that the HP 54600 family of scopes and logic analysers is made, known in-house by the collective nickname 'Jedi'.

Next morning I was given a most impressive hands-on demonstration of HP's new Infinium family of high-end digital scopes, by business team leader Dan Oldfield. Dan also described the US$1 million market research study that his team had commissioned at the start of the project, to find out exactly what typical high-end scope users didn't like about existing instruments. He then explained how the team had gone about designing the new instruments, and proudly showed me how they'd made

them so much more 'user friendly', by incorporating a full mouse-driven Windows 95 graphical user interface, and online help system.

After Dan's run-through, I was able to configure a sample Infinium scope surprisingly easily and quickly for a fairly complex triggering mode — quite impressive.

Dan then took me around the factory areas where the Infinium scopes and Jedi family instruments are made, and I was able to see them being assembled and tested.

My final meeting was with Jedi-family product manager Jerry Murphy, whom I remember meeting back in 1991 when he visited Australia for the launch of the HP 54601A scope. Jerry greeted me very warmly, especially because his team had appreciated the review I did last year (September 1996) of their impressive new HP 54645D 100MHz Mixed Signal Scope.

It was very interesting learning from Jerry the background to the development of the 54645D. Despite what I had thought, the planning for this innovative instrument had actually begun before that for the 54620A Logic Analyser, which I reviewed in the June 1995 issue. But the 54645D involved breaking quite a lot of new ground, technology wise, and as a result it took longer to complete. Luckily much of the work they'd done could be used to speed up development of the 54620A, though.

Jerry took me for another tour around the Colorado Springs facility, just before I was due to take a cab to the Colorado Springs airport to begin the long multi-hop flight home. It was something of an eye-opener to see the way HP clearly values and looks after its employees — I saw a fitness centre, medical centre, tennis and basketball courts, golf putting green and many very pleasant lunch/picnic areas, quite apart from the very well appointed cafeteria. Of course there's also quite a few large on-site parking areas, for employee cars...

Part of the SMD pick and place area at HP's Colorado Springs facility, with two operators seen setting up the machines.

Sensing the way

Overall then, the trip was very interesting and worthwhile, because of the opportunity to meet the people behind those impressive Hewlett-Packard T&M products, and also of course seeing them being made and tested. It certainly gave me a much richer understanding of what makes HP's products the way they are.

But what about any insights I might have gained into the company itself, and the reasons for its ongoing success? I believe this happened too, although it's harder to explain. Perhaps that's because it tends to happen slowly, by a kind of 'osmosis' — seeping into you in a cumulative way, rather than as a result of any specific event or events.

On the long flight over there, I had been able to refresh and expand my knowledge of HP's origins and development by reading Dave Packard's book *The HP Way: How Bill Hewlett and I Built Our Company* (HarperCollins 1995, ISBN 0-88730-747-7). Mr Packard wrote this only 18 months or so before he died in March last year, and about three years after he'd gone back out of retirement to help sort out some problems that HP struck in the early 1990s. I suspect he'd come to the conclusion that many of those problems had been due to some of the employees having forgotten the 'HP Way', and wrote the book to help prevent that happening again...

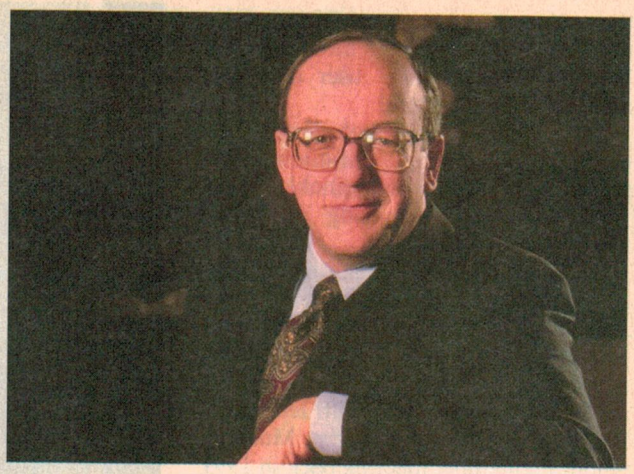
Reading the book, I did *start* to get more of a feel for the HP Way. Clearly it involves committment to a set of operating principles, including ongoing technical innovation; providing cus-

Janele Krause performing final testing of HP's new Infinium scopes, at the Colorado Springs facility. Note the rear panels of the scopes in the foreground, revealing their computer-based architecture.

tomers with the highest quality products; an emphasis on growth, in order to achieve strength and stability; strict codes of business ethics; not forgetting the need to make a profit, to fund growth and ensure ongoing viability; promoting from within the organisation, wherever possible; allowing flexible working hours; and also dedication to maintaining a corporate organisation and culture which is based on trust, mutual respect and consultation, so that both the company and its employees can achieve their maximum potential.

Which all sounds very well, of course — because a lot of it is like the proverbial 'motherhood and apple pie', and has been loudly professed by CEOs of all kinds of companies. Yet in most cases, you only have to visit a lot of these companies for a few hours to realise that in reality, they only pay lip service to such principles. After visiting quite a few companies over the years, I guess I've become a wee bit skeptical about *any* company that professes to have such idealistic goals...

So what's all that different about HP? Well, I'm hardly an expert; after all, I've only spent a week or so touring some of their facilities, and the closest I got to meeting one of their VPs was over a phone hookup. But I did manage to meet and talk with a few dozen HP people, at various levels from divisional general manager down, and in some cases I was able to talk with them very informally over a pleasant meal. And of course in the past I have used and reviewed quite a few of the company's excellent products, as well as having dealt for many years with the very helpful PR people at HP Australia.



Current Hewlett-Packard chairman, president and CEO Lew Platt, who has led the HP corporate team for the last five years or so. It's been a period of very impressive growth.

But frankly, I was impressed with how enthusiastic and proud almost everyone seemed to be, both about *their* products and *their* company. And I mean that emphasis on the words 'their' — because so many HP people *do* seem to have a strong ethos of collective proprietorship.

Perhaps it's partly because a lot of HP employees share directly in the company's profit, as a result of share-option and profit sharing schemes that have operated for most of its history. But also, I suspect, it's because the company *does* actually seem to believe in, and put into practice, most of those 'motherhood and apple pie' principles.

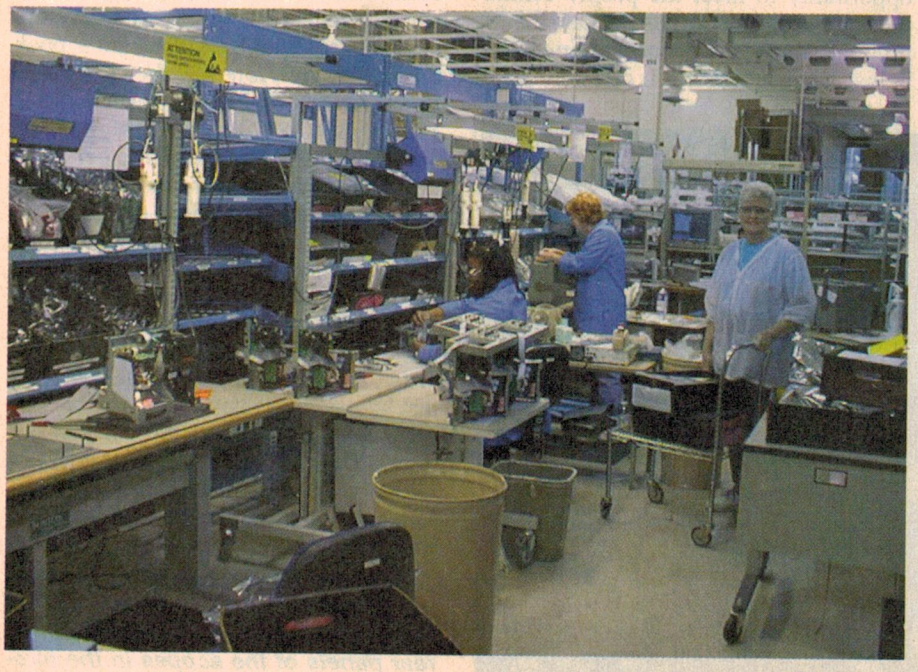
If this wasn't the case, I really don't think I would have come across so many people who seemed genuinely proud of the achievements of their particular HP team or division — or so clearly delighted that their products were held in high regard by an 'outsider' like myself. Or who seem to genuinely regard 'Bill and Dave' as their mentors — even though many of them had never actually met the founders.

And the bottom line seems to be that HP's belief and continuing focus on these basic principles of 'enlightened corporate democracy' really does work. The company continues to grow and prosper, its employees deliver an enviable level of productivity, its shareholders continue to get a good return on their investment, and of course its customers continue to be offered leading-edge products of very high quality, for a competitive price.

I guess it's a bit like the best tasting eggs coming from contented free-range hens, isn't it? I really wonder why so many companies still haven't discovered this home truth, and try to treat their employees like battery fowls. Perhaps a few more CEOs need to read Dave Packard's book...

From what I was able to see and judge from this trip, Bill and Dave really have built an outstandingly successful company, as well as one that continues to produce innovative and high quality hi-tech products. I look forward to being able to review more of these in the future, because I feel sure they'll continue to impress us.

My grateful thanks to Hewlett-Packard for the opportunity to tour their T&M facilities, and to the many friendly HP people I was able to meet. And last but by no means least, my special thanks to Cate Rejman of HP's Melbourne office, for all of her work in organising the trip. ❖



Part of the Colorado Springs assembly area, for the HP 54600 series of 'Jedi' scopes and logic analysers. At right is assembly group leader Donna Kesterton.

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Cat. No. 5064 **Citizen IDP3530 Parallel Printer** $525

Cat. No. 5065 **Citizen IDP3530 Serial Printer** $550

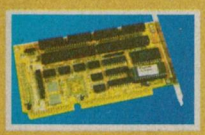
Cat. No. 5284 **Citizen IDP3540 Parallel Printer** $560

Cat. No. 5285 **Citizen IDP3540 Serial Printer** $620

Cat. No. 5067 **Citizen IDP3541 Serial Printer** $745

Cat. No. 5066 **Citizen IDP3541 Parallel Printer** $715

8 EIDE Device Card



This card supports up to 8 EIDE devices in a single slot. It has an on-board intelligent ROM BIOS that configures all drives automatically without need of additional software drivers. Other features include:-

- Provides 8 selectable I/O port addresses & IRQ's
- Supports DOS, Windows, Win 95, Windows NT, UNIX, SCO UNIX, Novell Netware 2.x,3.x,4.x, OS/2 2.0, Warp.

Cat. No. 2320 **ISA Quad-Channel EIDE Card** $199

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Control the printer remotely without leaving your computer! Unlike virtual Bi-Tronic auto switches, this switch simultaneousy communicates to both computers. It features IEEE-1284 and Centronics autodetection and is HP LaserJet, DeskJet compatible.

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We also carry the standard printer switch boxes

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Simply connect via keyboard or serial port. Features include:

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Cat. No. 8107 **22 Key Numeric Keypad** $132

Also available are a 26 key calculator keypad with LCD display and an 18 key keypad keyboard wedge model.

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Cat. No. 6200 / 6224 **IDE Tray / Frame Only** $70

Cat. No. 6201 / 6225 **SCSI Tray / Frame Only** $76

Cat. No. 6327 **SCSI Fast Wide** $169

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An external IDE Bus CD ROM 20x speed drive & case which connects to any parallel port. It includes built-in power supply, pass-through printer port and MS-DOS/Windows 3.1x, Win 95 & OS/2 Warp drivers. Achieve data transfer rates up to 960 KB/sec with an EPP (Enhanced Parallel Port). It can be connected to LPT1, 2 or 3 & has external audio connectors. Daisy chain up to 2 drives plus printer.

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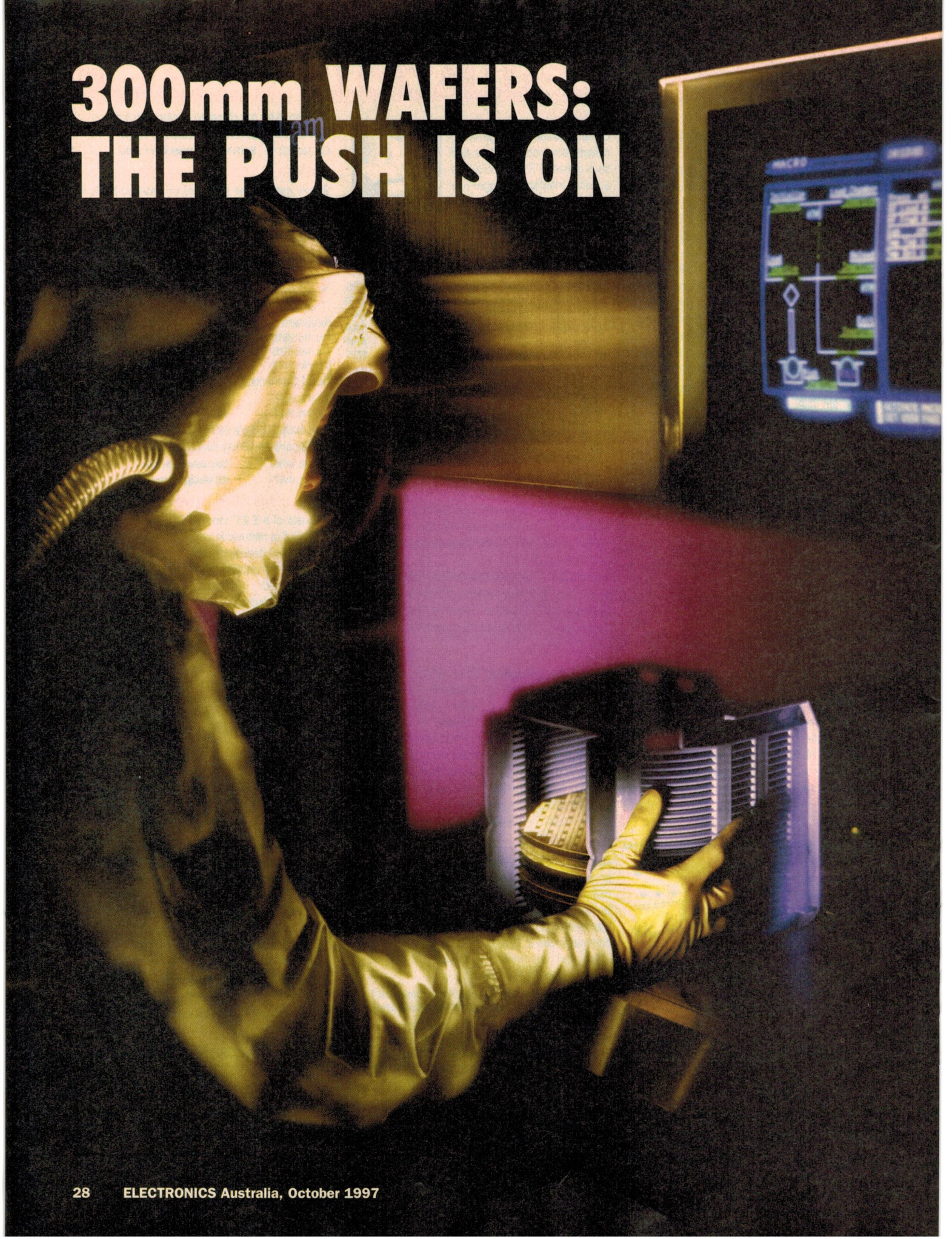
300mm WAFERS: THE PUSH IS ON



Economic pressures are forcing the world's chipmakers to plan on upgrading their fab plants to handle 300mm (12") diameter silicon wafers, just as they're being driven inexorably towards 0.1-micron process technology. The trouble is that many of the production tools needed for these transitions are still only in the experimental phase — and when they do become available, they're likely to be horrendously expensive.

by PAUL SWART and MARK HARRIS

You can't really appreciate how huge a 300mm (12 inch) silicon wafer is until you've held one in your hands — and hoped nothing unexpected would happen to cause the brittle, 1mm thin slice of polished sand to break. At present they're typically worth about US$1500 each...

Another way to appreciate the impact of this future generation of wafers is to put one alongside current industry standard 150mm (6") or even 200mm (8") wafers. It's obvious that these wafers the size of a medium-size pizza will hold vastly more chips, and thus enable chipmakers to produce future memory and logic chips more cost effectively.

In fact, Dataquest senior semiconductor equipment market analyst Clark Fuhs said at the recent Semicon West trade show in San Francisco that chipmakers can expect to be able to produce chips at a 30% to 40% lower cost, using the larger wafers.

In the chip business there has never been a single cost-reducing factor of that magnitude, and the promise of such savings is clearly driving the huge interest chipmakers appeared to have in the 300mm production tools shown at Semicon West.

The industry took a big leap forward in making 300mm production a reality this July, when it was announced that rival Japanese, US and European equipment and chip industry trade groups had agreed on the obvious: to develop a single set of standards, starting with the size and shape of the wafers themselves and the cassettes in which they are carried around in the fab plants, from tool to tool. Additional standards are in the works for the 'loadport' where wafer cassettes are placed, and from which individual or stacks of wafers are loading into the processing tool.

Despite the apparent euphoria over the standards agreement, it was obvious at the Semicon show that there are still many major hurdles to overcome before the first high-volume 300mm wafer fab is up and running. This is probably something that should not be expected until 2000 at the earliest.

Missing links

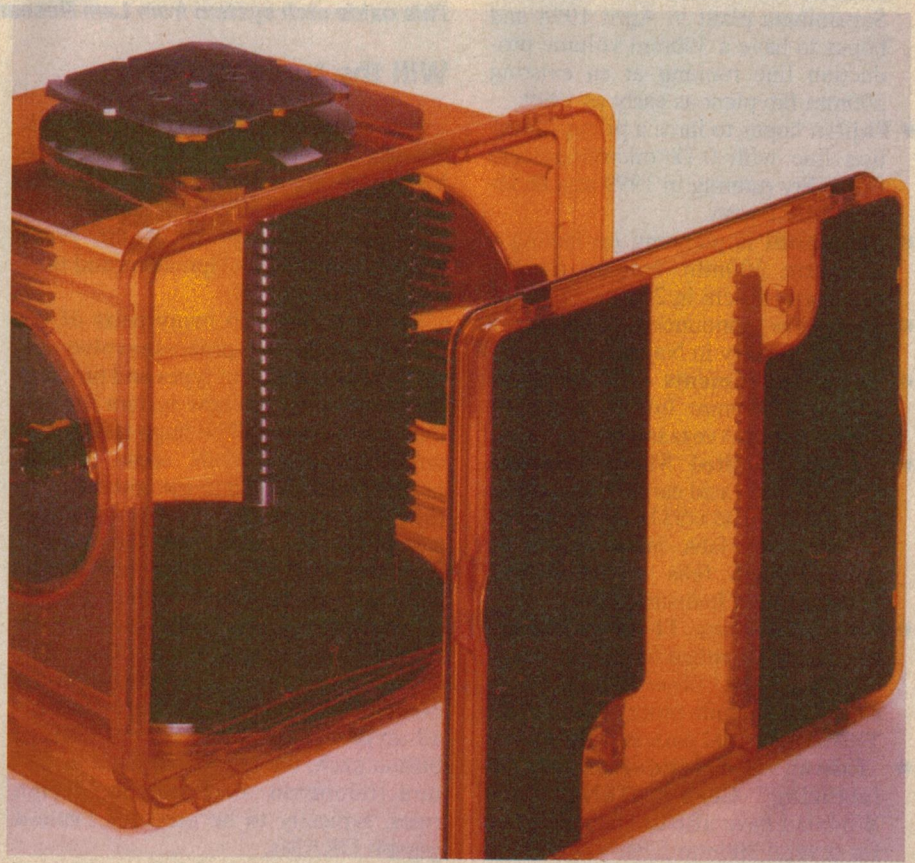
Because of the complexity in making advanced semiconductors, there are literally hundreds of pieces of equipment that must be integrated to create a complete wafer fab line. Most of these tools represent just one — but often a critical — step in the 300-800 process steps that are needed to make an advanced three-to-five layer metal interconnect microprocessor, for example.

To date, only a fraction of the necessary tools are readily available for 300mm processing. The majority of 300mm tools are still in prototype development, with only a handful suitable for shipment today to the advanced research laboratories of major chip producers.

The problem is that in a majority of cases, existing equipment designs and processes are unsuitable to facilitate handling the much larger 300mm wafers. A good example is the industry standard vertical furnaces used in most chemical vapour deposition (CVD) systems. Not only will the high temperatures inside those furnaces make the wafer crumble like a potato chip, it is practically impossible to control gas flow dynamics in such as way that ultra thin (often only 100-300 Angstrom) films of materials can be deposited evenly over the entire surface of each of the dozen or more wafers processed simultaneously, stacked less than an inch apart in such furnaces.

New system designs and process technologies will be needed for many of the steps in the processing of 300mm wafers. That is both very expensive, and — more importantly — very time consuming.

With so many companies still feverishly developing solutions for 300mm processing, it will therefore still be some



Up to twenty-two 300mm wafers can be transported safely between process stations with Fluoroware's new cassette. Handles on the side and top allow reliable handling by both humans and robots.

time before chipmakers will have a chance to build a complete prototype production line.

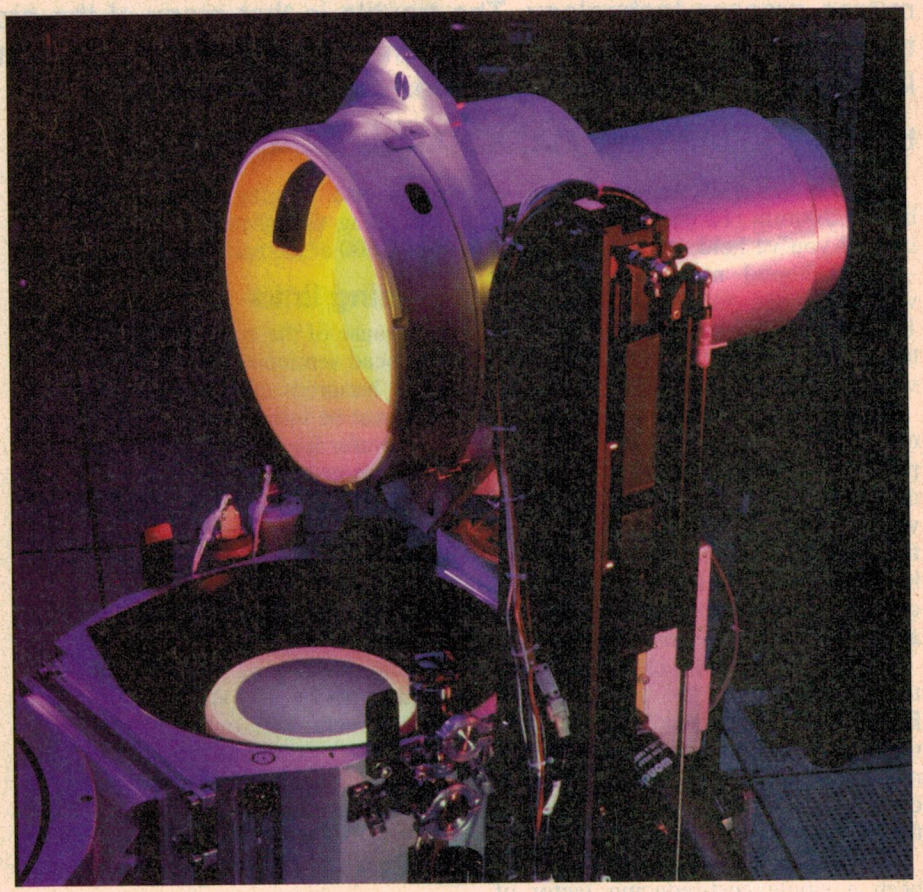
The first 300mm pilot production lines are expected for late 1998 or early 1999, according to George Lee, Director of the 300mm Initiative sponsored by the Semiconductor Equipment & Materials International (SEMI) trade group in Mountain View (see graph). The best-case scenario calls for as many as eight pilot production lines to be built by the end of 1998, with another nine to follow in 1999. The first high-volume production line isn't expected until some time in 2000.

But that is assuming that equipment makers will be able to deliver the needed tools. And that, according to all indications, is still a very big and bold assumption...

Plans announced

This year, a number of major chipmakers have announced 300mm fab plans, including Intel which said last year that it would focus most of its R&D efforts on improving 200mm-based production. Here is a brief overview of the 300mm plans that have been announced to date:

- **NEC** has announced plans to install 300mm tools in the R&D lab of its Sagamihara plant in April 1998 and hopes to have a 300mm volume production line running at an existing 200mm fab plant as early as 1999.
- **Fujitsu** hopes to have a pilot production line with 0.18 micron process capability running in 1999 at a factory in Mie, Japan.
- **Mitsubishi** is planning on having a complete 300mm volume facility running in Kochi in 2000.
- **Sony** has announced plans for a 300mm facility in Nagasaki.
- **Texas Instruments** is planning on adding a 300mm line to either its Dallas fab or Avezzano fab in Italy.
- Taiwan's **United Microelectronics Corp.** (UMC) said earlier this summer that it will spend US$18 billion on half a dozen new fabs, including one or more 300mm fabs at the Taiwan Science Based Industrial Park.
- The US/Taiwanese **TI-Acer** joint venture recently applied for permission to build a US$18 billion 300mm fab on a 0.16 square mile piece of land in the TSBIP industrial park in Taiwan.
- **Taiwan Semiconductor Manufacturing Corp.** (TSNC) and Winbond have also announced plans for several 300mm fabs.



This oxide etch system from Lam Research was designed to hold 300mm wafers.

Will the tools work?

Full scale, cost-effective 300mm production is a proposition that few industry experts are willing to place a bet on, in terms of feasibility in the next three to five years, despite all of the brave announcements by chipmakers and their equipment suppliers.

That's because so many parts of the 300mm production process involve radically new equipment types and processes. Qualifying each new system for volume production will be huge task facing any chipmaker. While some 300mm production is certain to get under way in the next two or three years, cost-effective production may elude the industry until around 2005 — when most equipment makers will have second-generation tools that will have improved on the imperfections of their initial offerings.

To get their money's worth out of the 300mm wafer fabs, which will carry all-up price tags in the order of US$2-3 billion each, the chips will have to feature minimum 0.18-micron design rules, typically to be used for 1-and-4 gigabit DRAMs.

So not only are equipment makers facing the challenge of creating new tools and processes for 300mm wafers, those tools and processes must also achieve minimum process requirements in a regime no one has any experience with, even at 200mm wafer fabs where 0.35-micron lines (for 64 megabit DRAMs) are just now going into high volume production at a significant number of plants around the world. For many equipment makers, 0.35-micron already stretched their technologies to the limit for feasibility.

Lithography is one of the key areas where a huge amount of research is being concentrated, to make tools that are not only capable of printing 0.18-micron patterns (equivalent to printing 550 circuit lines on the width of a human hair!), but will at the same time offer the potential of going one or more generations further down (to 0.13 and 0.1 micron). Tools that span two or more product generations are a standard requirement, for meeting chipmakers' demands to be able to both shrink the size of existing chips and also produce their next-generation chips on the same

production line.

In other areas of the production process, such as etch and CVD, companies like Applied Materials and Lam Research either have first-generation 300mm tools ready to ship to the research labs of their customers, or they have developed the ability to adjust their existing tools to handle 300mm wafers.

No wafers, yet

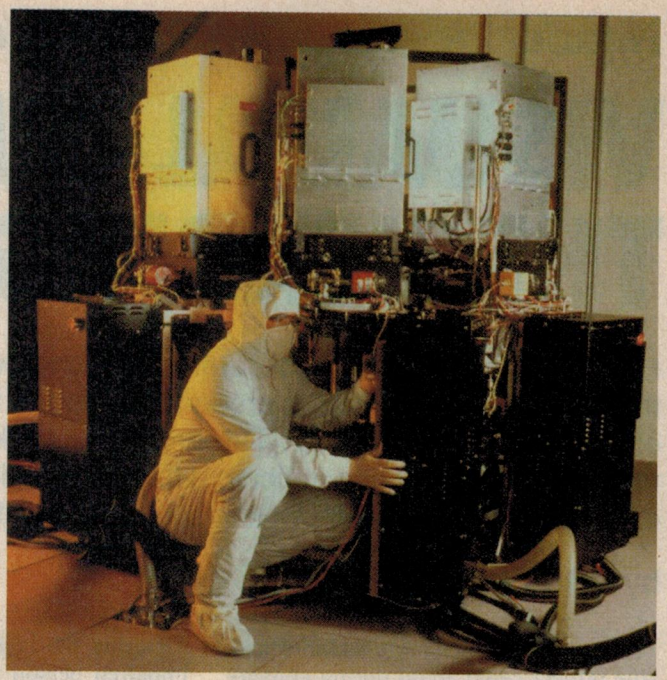
With the exception of a few test wafers, there is no wafer production capacity today to facilitate the demand of even a single 300mm wafer line.

Currently, 300mm wafers still cost more than US$1000 each, a price at which they are more a novelty than a viable commodity for serious production research. Chipmakers easily burn through thousands of test wafers before any chips are 'cut' to make useful devices.

300mm wafer prices are not expected to come down significantly any time soon. According to Tim Woolridge of Texas Instruments, to be economical the price needs to come down to around US$400 per wafer by 2001.

Already wafer producers have a hard enough time manufacturing enough 150mm and 200mm wafers for current production needs. And they too face huge development costs, for new furnaces and techniques to pull the huge ingots with the incredible level of purity and consistency required for 0.18-micron processing. Also blade-based cutting has all but been ruled out for slicing through the 12"-diameter bars of silicon. However the alternative wire-based cutting is significantly slower...

Steve Bronkhorst, director of 300mm development at wafer maker MEMC in St Peters, Missouri, said the US$400 price level would have been unrealistic a year ago. "But as we get further into this transition and begin to manufacture 300mm wafers, there are signs that this figure ($400) may not be so unrealistic."



A research engineer adjusting an experimental 300mm multi million-dollar etch production tool in the R&D laboratory at Lam Research in Silicon Valley.

Bronkhorst estimates that the wafer industry will need to develop the capacity to produce around 25,000 300mm wafers per month in the next two or three years, as half a dozen chip makers will be setting up pilot production lines, which typically each consume between 3000 and 7000 wafers per month.

Taiwan's gamble

Perhaps the most surprising development in the transition to 300mm is the huge commitment being made to it by the Taiwanese industry. If the dozen or so 300mm fabs currently on the drawing boards are built according to schedule, it would propel Taiwan's chip production to rival that of Japan, Korea, and even the United States.

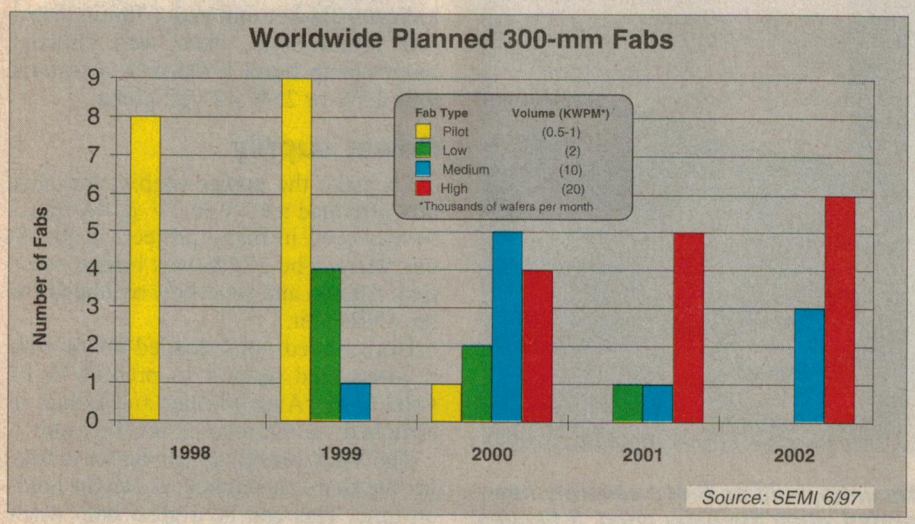
The push for 300mm production in Taiwan is driven by the country's concerted effort to develop the chip production capability and quality needed to give Korean and Japanese DRAM makers a 'run for their money'.

Earlier, aggressive deployment of 200mm fabs raised plenty of eyebrows. But that reaction is nothing compared to the sighs of disbelief heard around the world about Taiwan's 300mm efforts. Taiwan chipmakers generally lack the kind of experience and expertise in chip manufacturing technology development their US, Japanese and Korean competitors have gained over the last 20 years. As such they would be more likely to use proven 200mm production tools and techniques.

Some analysts even caution that Taiwan is taking a huge gamble. If the first generation of 300mm wafer fabs perform below expectations due to equipment and processing problems, the Taiwan chip industry could be taking their huge investments in 300mm on the chin.

If it all works out, however, Taiwan will be producing DRAMs in huge volumes and at significantly lower costs than their competitors.

The sure winners in the 300mm transition, no doubt, will be the equipment industry — which will be able to reap in billions of dollars in new sales and profits from the 300mm tools. These will be hugely expensive, with price tags inflating to the US$10 million level on many etch and deposition systems. ❖



This chart, from SEMI, shows the number of 300mm pilot and production fabs scheduled for construction over the next five years.

Reader develops and builds a novel

VISUAL ALARM FOR THE HEARING IMPAIRED

How can hearing-impaired parents respond when the baby cries in its bedroom? Discovering there were no commercial products designed to solve this problem, the author decided to build one from 'bits and pieces'. The prototype worked so well that he built a more elaborate version using coded flashing to indicate different situations: baby crying, front doorbell, telephone ringing, or smoke alarm sounding. Here's how he did it...

by DON SMITH, VK3ASD

The idea for this simple and inexpensive project came about during conversations with a severely hearing impaired mother-to-be, when the ramifications of the impending arrival of her first child were being discussed. The concern was that she and her husband were unable to find a suitable Baby Alarm for Junior. All the baby alarms readily available were adaptations of the simple household Talk Back System, to amplify sounds from the baby's room to a remote receiver.

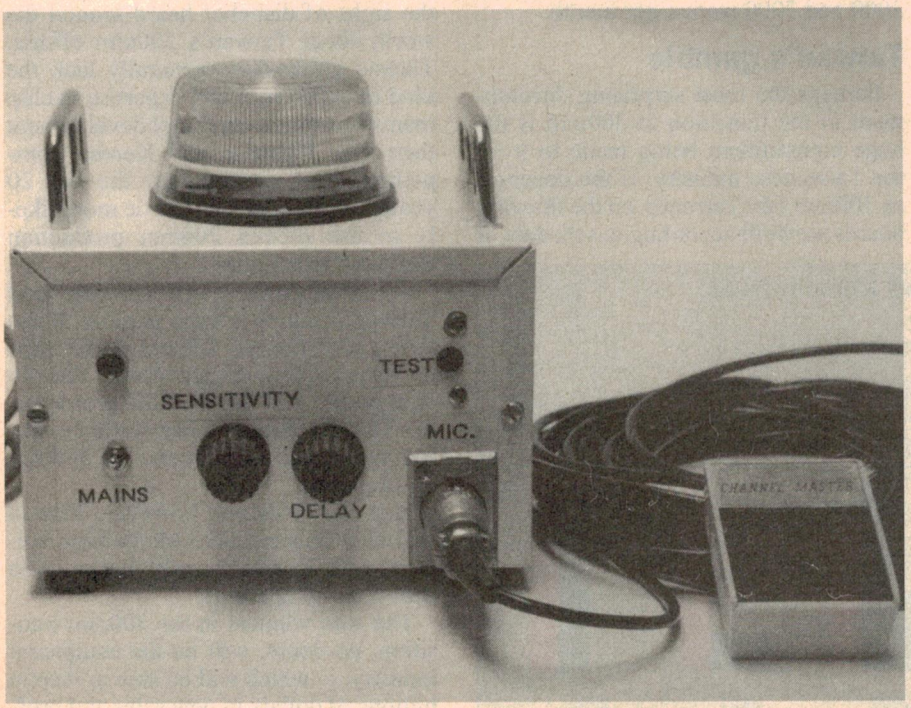
During the hours of sleep, a hearing impaired person removes their hearing aid(s) for comfort and, in the case of this mother to be, her hearing then reverted to its natural level of some minus 35-40dB. This ruled out the usefulness of acoustic type baby alarms. This was a worry for the parents, as every 3/4 hours or so Junior was undoubtably going to demand sustenance...

A flashing light alongside the parent's bed was suggested, and I dug into the files of sound operated devices to see what was available.

First the VOX unit. For this I used the Voice Operated Relay circuit described in the May issue of *ETI*. I had been using an adaptation of this unit for recording orbiting weather satellites for a number of years. It's very robust, very reliable, easily reproducable and easily modified to take the various relay bases on the market.

For the microphone, Mark 1 used a dynamic type (very robust for the time that Junior would be standing up in the cot and grabbing at all and sundry). Mark 2 used an electret type, with suitable modifications to the input of the VOX unit. A small plastic utility box was used to house the microphone and to provide an anchor point for the shielded two wire cable.

For the lamp and flasher, the automotive spares department of a large chain store provided a standard 12V turning indicator flasher unit and a 70mm diameter round style, clear lens chassis-mount lamp bezel fitted with a festoon type 15W or 25W 12 volt globe.



One of the author's prototype visual alarm units, built so that a severely hearing-impaired parent would be able to respond when the baby cried. It flashes the lamp when the microphone picks up sounds at a predetermined level, and lasting for a given time.

Power supply

To make the power supply, the junk box provided a 6.3V+6.3V @ 4A transformer used in many projects in previous years. The 12.6V was bridge rectified, filtered and (overkill) regulated for the VOX unit.

Unregulated volts, loaded down with a wirewound resistor to present 13/14 volts to the Auto Flasher and Lamp, is switched via the relay in the Vox unit.

The VOX sensitivity can be set to trigger the alarm as required, as can the hold-on time. This can be a great help when Junior is awake and playing, or when play time is over and action is demanded!

The whole unit is mounted inside a 130mm x 100mm aluminium box with rubber feet. The lamp is mounted on top, protected on either side by two 80mm x 30mm plated carrying handles.

The 'Mains On' LED and mains switch are on the left of the front panel box, and above the mic input socket on the right is a Test LED in parallel with the the alarm lamp, to prove that the unit is working if the main indicator lamp goes open circuit.

I had the main box painted in white baked enamel by a very obliging auto repair shop, when they were painting their next white car body. This provides a very tough finish and looks good.

This Unit has now been in use for over three years and the parents are very pleased with it. They have taken it with them on holidays and it hasn't missed a beat. The parents concerned have been approached by many people in an effort to obtain a similar unit, which apparently is not available on the open market.

Although this unit was developed to reduce the anxiety level of hearing impaired parents with very young children, I find that other uses are appearing.

A conversation with a representative of a Hearing Loss Assistance organization brought to my notice the serious situation where the spate of house fires has caused many people to fit smoke detectors. Where people have to take medication to help them sleep, they have voiced concerns as to not being able to hear the alarm whilst asleep.

Possibly the same basic unit could be used with the microphone situated near the smoke alarm, doorbell or telephone...

I have since extended this simple unit to provide visual alarms for the front door, the children's rooms and telephone, to provide a visual indication in the lounge room, kitchen, laundry, playroom and the back yard.

The new unit uses 555 timers/delays to cause the indicator lamps to flash at a pre-determined rate. All the design is available in articles on timers etc., which have been run in this magazine over the years. All that is required is to combine them into a simple system.

In all the above projects my main idea was to keep all mains associated circuitry safely enclosed in a well earthed metal box, with external voltages of only 12V DC for the VOX units and 24V AC for the lamps used in the fixed system.

I hope that this description of these simple units will encourage further improvement and marketing of units to fill a much neglected niche for people with a hearing loss. ❖

NOTES & ERRATA

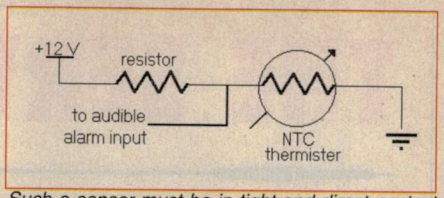
Icom Australia: The new address for Icom is 290-294 Albert Street, Brunswick 3056; phone (03) 9387 0666, fax (03) 9387 0022.

Car warning alarm (March 1997): Designer Glenn Pure has provided the following comments in response to the letter by Mike Clarke of Hamilton in NZ:

I fully agree that when monitoring engine temperature, the alarm must be used with caution because of the habit of engine manufacturers to place the temperature sensor in the water jacket — not in direct contact with the engine block or cylinder head. With this arrangement, a loss of engine coolant from the jacket means that the temperature sensor will not detect overheating until it may be too late!

However, his proposed solution of using a coolant level sensor may not be the best approach. Unless the level sensor itself is placed in the pressurised water jacket, it will fail to detect a sudden loss of coolant due to a blown radiator hose or some similar event. However, it would be very difficult to both design and fit a suitable coolant level sensor in the water jacket. Also, a level sensor placed in the coolant overflow reservoir will not be effective in these circumstances.

Luckily, there is an obvious solution. Simply fit a second temperature sensor, but attached directly to the engine, not in the water jacket. Connect this sensor to the spare input of the audible warning alarm. I would suggest a do-it-yourself sensor made from a negative temperature coefficient thermister (this is what vehicle manufacturers use anyway). The thermister could be potted into a small length of copper pipe, which has been hammered flat and drilled at one end for fixing to the engine.

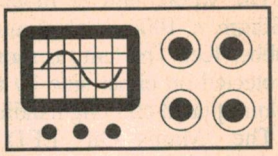


Such a sensor must be in tight and direct contact with the engine block or cylinder head — I would suggest bolting it on by 'piggybacking' off another component bolted onto the block or head. A few cautions, though:

- *Use a thermister rated to at least 150°C and with a resistance at engine operating temperature of around 1kW or more;*
- *When potting the thermister, only use a resin rated to 150°C or more (otherwise it might melt and your sensor will fall out);*
- *When selecting a place to fix the thermister, be careful not to loosen any critical component or create a leak of some type;*
- *Remember to stay away from the exhaust manifold, which will get much hotter than the engine during normal operation.*

The suggested circuit arrangement is attached. Select the resistor so its value is about equal to that of the thermister at normal engine operating temperature, thus producing about 6V of output. You will then need to adjust the trigger voltage for the corresponding input on the audible warning alarm. I would suggest measuring the output voltage during normal engine operation and shortly after engine switch off (the engine block can often equilibrate to a higher temperature a minute or two after switching off). Subtract a small margin from this of say 20-30%, and set the trigger voltage to this value. For example, if the output of the circuit is 6V at normal engine operating temperature, set the trigger voltage on the warning beeper to about 4.5 or 4V. ❖

THE SERVICEMAN



The old Sony CTV that kept on blowing one part after another!

Among the stories I have for you this month are a 'whodunnit' about a colour TV that wouldn't do anything much except blow a fuse in my meter, and another tale about an elderly Sony set that kept on blowing one component after another — partly because of a subtle servicing error. There's also story about equipment that is thrown out as 'junk' when it's still capable of working perfectly well, after just a little routine maintenance and TLC...

This month I am opening the column with a different sort of story. It's a simple tale, but one with a lesson for all who service switch-mode power supplies. I'll present it in the form of a puzzle with the symptoms and test procedures first, then the answer at the end of the column.

The fault showed up in one of my own television sets, but similar troubles can occur in dozens of different models, of many brands. This one was an NEC model N-3450 and the relevant part of the circuit is shown here.

The only symptom was a simple 'No Go'. Nothing worked, not even the Standby light.

I opened the set and found the main AC fuse was intact. I checked for continuity in the mains lead, from the plug to the on/off switch. That too was OK.

Next I began to check the bridge rectifier diodes, but there was a dull 'phuttt' from inside my multimeter and it stopped working. After replacing the fuse in the meter, I switched it over to Volts and soon found there was 300-plus volts on the main filter capacitor...

I discharged the capacitor, then checked the switching IC, one of those five-pin flat pack devices. It was not shorted (the usual failure mode for these components), nor could I find any leakage that might account for a no-go condition.

At this point I sat down to have a think about the problem. I suggest you do the same, and I'll give you the answer at the end of the column!

Reclaiming 'junk'

Now on to our next item, which comes from contributor Gavin Rogers, of Duncraig in WA. Gavin opens his story with a comment many of us have made in recent years. I'm afraid that the term 'Throw-away Society' applies not only to the domestic scene. It extends right up the scale to the highest levels of commerce and industry.

Here's what Gavin has to say...

It amazes me how often some people are willing to throw something out, because of a minor mechanical or electrical fault, without considering the prospect of repair.

It seems that many businesses simply do not have the will to repair their office equipment; buying a new model to replace the broken one seems to be the preferred action.

A friend of mine recently started working for a small company and one of his first jobs was to clean out the store room. And what a store room that was! Filled with everything from broken chairs to abandoned and unloved printers, photocopiers and computers. My friend, knowing of my interest in computers, offered me some of the equipment that he had been told to "...throw on the tip!"

Most of the equipment was truly 'beyond repair'. One monitor had obviously fallen off a desk and although the tube wasn't damaged, it had broken away from its plastic mounts and was hanging loose inside the case. After sorting through the real rubbish, I picked out two printers that I felt might offer some hope and I took them home with me.

The first one I looked at was an NEC 'Pinwriter' model P5300. After a quick check to see that there were no obvious faults with the power lead, I plugged it in and switched on. All that happened was that the print head moved about one centimetre, then stopped. I tried again, with the same result except that this time the movement was accompanied by a grinding, crunching noise.

At this point I decided that nothing could be done outside the case, so I took the cover off and to say that I was shocked would be an understatement. The whole bottom of the machine was covered in a thick, black, greasy dust and the shaft of the small motor that drove the printhead was siezed solid, or nearly so.

At first I thought the muck might be a ground-up printhead drive belt. These are made from a black rubber material and can sometimes get chewed up by the mechanism. I don't know what the material was, but it wasn't the belt — that was still sound. Once I had cleared the mess from around the motor, the machine fired up and worked perfectly.

I was able to untangle most of the muck from inside the printer and gave all the moving parts a touch of lubricant.

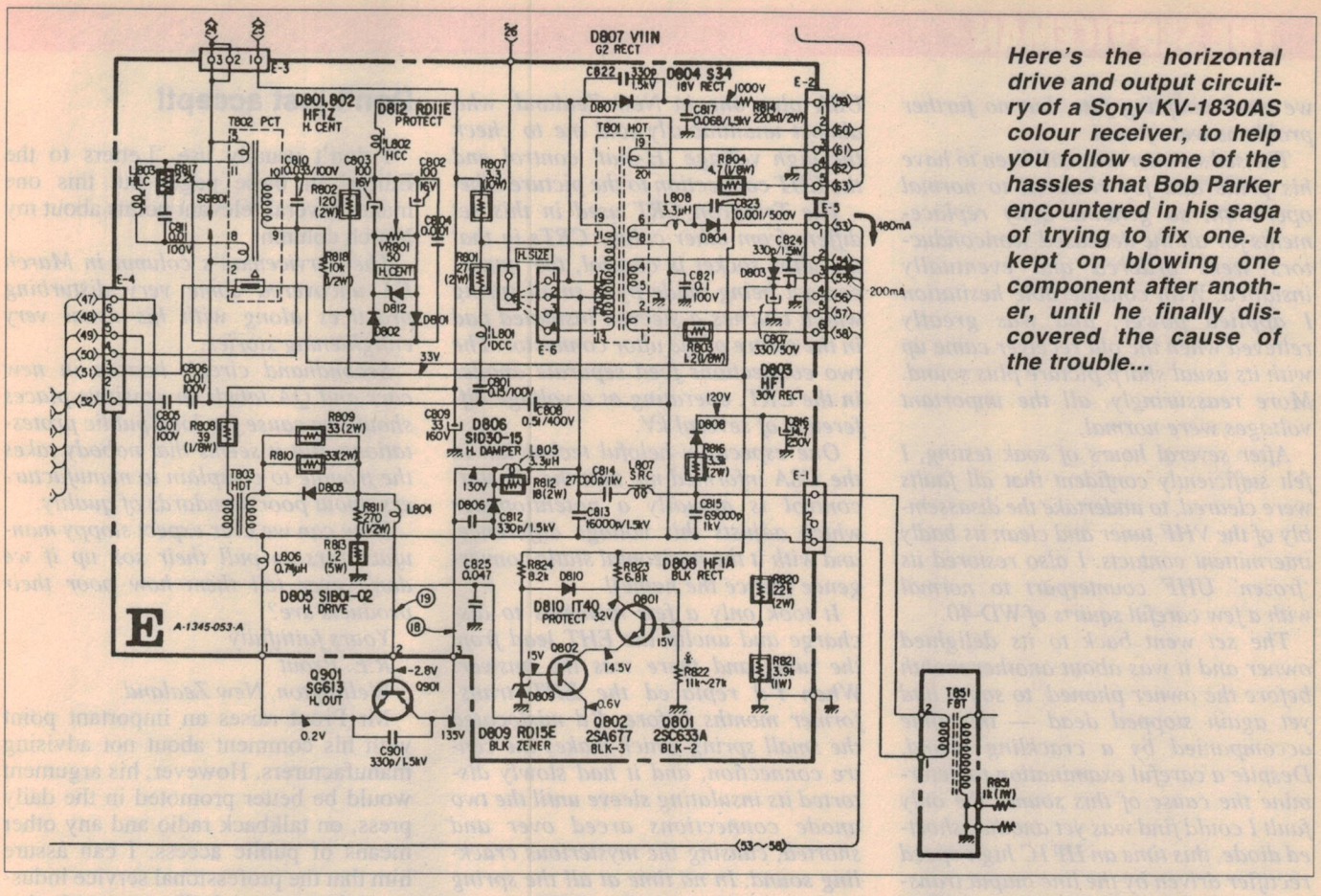
The next time I powered the printer, I held down the appropriate control buttons to prompt the machine to 'Self Test'. It did this quite successfully, although with only an ancient, dried up ribbon, I couldn't be sure that the test was perfect.

To top it all off, my friend arrived next day with a large envelope he had found among the rubbish on its way to the tip. Inside was the printer's User Manual and a brand new ribbon. Whoever had been the previous manager of that store room had kept all the printer's accessories, just in case. How helpful!

I now use this printer as my 'work horse' and it does a fine job. So for the investment of only a few minutes of my time in simple maintenance, I have reclaimed a once 'worthless' printer and restored it to top working order.

The second of my two junked printers might need more work — I have not had time to look at it yet. That might make another story for the future.

Thanks for that story, Gavin. It's distressing to think about all the quite useful items that are thrown on the tip simply because someone has no use for them. As you have shown here, in many cases it only takes a bit of belated maintenance to restore the product



Here's the horizontal drive and output circuitry of a Sony KV-1830AS colour receiver, to help you follow some of the hassles that Bob Parker encountered in his saga of trying to fix one. It kept on blowing one component after another, until he finally discovered the cause of the trouble...

to good working order.

Of course, these days not every item has to break down before it is junked. Just recently one of my customers asked me if I knew of anyone who wanted a complete computer system, in good working order. I asked no questions but next morning went over to collect the gear.

It turned out to be a BBC Model B micro with expanded memory, a monochrome monitor, disc drive and an Epson printer, all in perfect condition. Included with the 'deal' was a quantity of software and a pile of 5" floppies.

At the moment I don't know of anyone who would be likely to buy this computer system, but one day I'll find someone. It will probably be a student who needs a simple word processor, but whose parents can't afford a 'bells and whistles' PC. I'll be quite happy to hand it over for next to nothing.

The alternative, of course, was that the equipment would have finished on the tip.

By coincidence, I am writing this column on an identical BBC system, for which I paid over $2000 in 1984. My customer would have paid about the same price, yet here she was giving it all away, simply because now she has a bigger and better system, which cost less than the old one!

Well, I too have got a bigger and better system, but there are some things that this 'ancient' BBC will do better than the PC. So I'll hang onto the relic for as long as I can find a use for it.

Thanks again for your story Gavin. And you'll let us know how the other printer worked out, won't you?

Horrendous tale

Next, we have a story from Bob Parker, of Carlton in New South Wales. Bob tells a horrendous tale of problems with an old Sony colour TV. This particular model is certainly not one of my favourites, so Bob is to be commended for his persistence in restoring this example. Here is what he has to say;

Here's a bit of a 'saga' which seems to contain a moral or two, about an old Sony KV-1830AS TV receiver belonging to a friend.

This particular set had been well looked after and had produced a first-class picture for about two decades, until it suddenly stopped dead in mid-program. Checks indicated a power supply overload and after replacing several open-circuit electrolytic capacitors (pinpointed by an Electronics Australia ESR meter!) in the horizontal output stage, I established that the EHT transformer had a shorted winding.

Since the set had become something of a family heirloom, the owner consented to pay the $125 price of the new transformer and a replacement was duly fitted. The set was quickly restored to its former glory.

But to my dismay, about a month later the owner called to tell me the Sony had 'died' again. This time the power supply's main switching transistor, emitter resistors and several other components had been destroyed. Once these had all been replaced, more checking revealed the horizontal output stage damper diode, a GH3F, was shorted.

Not having ready access to this diode type, I replaced it with a BY228 damper diode rated at 1500V and 1.75A. However this was not such a wise move — because the moment I applied power, the SG613 horizontal deflection SCR (costing nearly $30.00!) gave up the ghost, along with a V11N high voltage diode. Both of which had tested OK previously. The BY228 was no worse for the experience, however.

At this point I decided I was not going to apply power again until I was certain there were no other faulty components. So a colleague and I went right over the entire horizontal deflection circuit with ohm and capacitance meters. We knew

we were tempting fate, but no further problems were found.

The set's owner was still keen to have his pride and joy restored to normal operation, so genuine Sony replacements for all the deceased semiconductors were ordered and eventually installed. With considerable hesitation I applied power, and was greatly relieved when the old receiver came up with its usual sharp picture plus sound. More reassuringly, all the important voltages were normal.

After several hours of soak testing, I felt sufficiently confident that all faults were cleared, to undertake the disassembly of the VHF tuner and clean its badly intermittent contacts. I also restored its 'frozen' UHF counterpart to normal with a few careful squirts of WD-40.

The set went back to its delighted owner and it was about another month before the owner phoned, to say it had yet again stopped dead — this time accompanied by a crackling sound. Despite a careful examination to determine the cause of this sound, the only fault I could find was yet another shorted diode, this time an HF1C high-speed rectifier driven by the line output transformer, which produces the +200V supply for the video output stages.

I felt I couldn't get into too much trouble by replacing it with a similar diode from another brand of TV. But as the tube warmed up I was horrified to see that there were three separate horizontally-displaced images on the screen, all of them a dreadful shade of green! Checks with the trusty CRO showed the horizontal output stage waveforms and the drive to the CRT guns were normal, and even the EHT measured OK at about 24kV.

In view of the problems caused by non-original parts earlier, I ordered and installed a genuine HF1C diode; but this made not the slightest difference. Being short of time I handed over the set to my colleague, who once again tested many components in the horizontal output and other stages, but again drew a complete blank.

By now both of us were open to any and all reasonable suggestions, so in something of a state of desperation I decided to fire up the computer, get on the Internet and post a message on the Science.Electronics.Repair newsgroup, describing the symptoms and asking for help.

In less than 24 hours I received e-mails from several technicians in the USA plus one in New Zealand, who almost unanimously told me to check the high voltage 'H-stat' control and the EHT connection to the picture tube.

The Trinitron CRT used in this set differs from other colour CRTs in that the ultor socket is coaxial, the 'inner' contact being made by a small spring which touches a sleeved insulated pad in the centre of the ultor connector. The two connections feed separate anodes in the CRT, operating at a voltage difference of several kV.

One especially helpful technician in the USA informed me that the 'H-stat' control is actually a potentiometer which adjusts this voltage difference, and with it the horizontal static convergence (hence the name)!

It took only a few moments to discharge and unclip the EHT lead from the tube, and there was the answer! When I'd replaced the EHT transformer months before, I'd mislocated the small spring which makes the centre connection, and it had slowly distorted its insulating sleeve until the two anode connections arced over and shorted, causing the mysterious crackling sound. In no time at all the spring was straightened, the EHT system returned to normal, and up came the familiar excellent picture.

At the time of writing the set has been operating so perfectly that it looks like it will be going well into the next millenium. But one question still remains unanswered: why did the +200V rectifier diode fail at the same time as the anode cap arced over? Perhaps we will never know; all I can think of is that the electromagnetic pulse generated by the arc-over had something to do with it...

Well, Bob, as I said at the start of your story, you deserve a medal for persistence if nothing else. I've struck most of the faults you have recorded here (though not in the same set) and the result is that I have no love for the model. Faced with a series of faults as you were, I would more likely have told the owner to take it elsewhere.

Possibly the reason I don't like these sets is that they seem to contain far more components than other sets need to do the same job. This means more chances for breakdown and more hunting about to find the faulty part. This didn't seem to worry you Bob, and by now you are a full bottle on Sony line output stages. Congratulations, and thanks again for the story.

Don't just accept!

I don't usually use 'Letters to the Editor' in these pages but this one makes several relevant points about my March column:

The Serviceman's column in March EA uncovered some very disturbing practices along with his usual very enlightening stories.

Secondhand circuit boards in new cars and QA labels in sensitive places should be cause for loud public protestations. But it seems that nobody takes the trouble to complain to manufacturers about poor standards of quality.

How can we ever expect sloppy manufacturers to pull their sox up if we don't ever tell them how poor their products are?

Yours faithfully
R.E. Prout
Wellington, New Zealand.

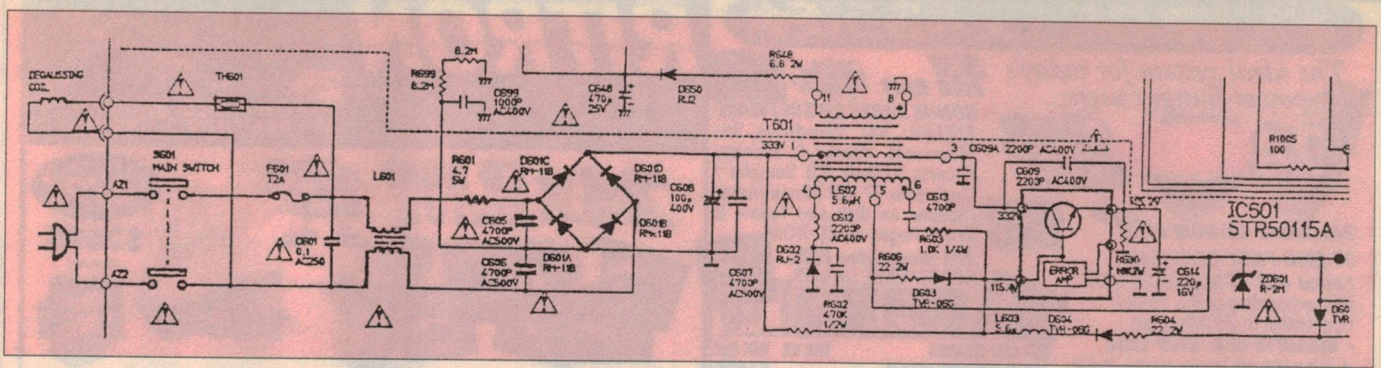
Mr Prout raises an important point with his comment about not advising manufacturers. However, his argument would be better promoted in the daily press, on talkback radio and any other means of public access. I can assure him that the professional service industry makes a special effort to supply that sort of feedback.

As far as the car computer in the March story was concerned, I believe the car owner was a solicitor and he threatened to make loud legal noises to the car distributor and manufacturer. I never did hear the outcome, but I suspect the result was a loud "Ho! Ho! Just try it on!" from the manufacturer. Not even a legal-eagle car owner has much leverage over a multi-national car maker.

In the matter of the QA sticker, the problem is a bit more confused. Sticky labels do not always finish up where they are put. They can also come loose afterwards and, under the guidance of Edsel Murphy, come to rest in the most inopportune spot. So complaints to the manufactures might be unfair. Only if a lot of labels turned in the same touchy spot would there be justification in complaining.

Nevertheless, I suspect that the result of a complaint would be as for the car computer above, since most domestic appliances are now made by a few large multi-nationals.

As I mentioned above, the best course of action is to complain loud and long through whatever public media are open and available. Personally, I have a slightly different approach.



The power supply circuitry for an NEC model N-3450 CTV. The set stubbornly refused to go — not even the standby light was illuminated. Yet the main reservoir cap was charged to 300V. Can you deduce the faulty component?

As a professional serviceman, I am in touch with most of the retailers around town. Whenever I come across poor quality or bad serviceability, I give full details to the managers of the stores. And I tell their customers.

I have known brands to disappear from stores around town after a particularly bad run of service problems. No retailer wants constant arguments with his customers, and any brand with a bad reputation is better off out of the market.

Of course, many of these 'bad' products are also very cheap, and there are customers who ignore warnings in pursuit of a bargain. Then there are the unscrupulous retailers who think nothing of unloading the inevitable repairs onto the service industry. No amount of publicity will ever avert this problem.

Preserving privacy

Another letter that came in recently also deserves space here, since it offers an opportunity to explain a policy matter. It's from Keith Vieritz, of Kallangur in Queensland:

Would it be possible for you to send me the address of one of your contributors? He is Walter Pierce of Croydon, NSW. His story was used in the October 1994 issue of Electronics Australia.

I have acquired an old Hammond organ which seems to fit the description of the one Mr Pierce has. This one was not working at all — in fact it was going to the tip, because it was considered to be beyond repair. Apparently it had not been working for some years.

After cleaning out all the mouse droppings and years of dust and grime, and repairing some broken stop switches, we gingerly switched on. My wife was eager to hear what it sounded like. We got some joy out of the upper manual but it was intermittent. There was nothing from the lower manual or the foot pedals, although there was plenty of hum.

My next move was to remove all the numerous circuit cards and to clean them thoroughly. Some of the edge connectors were badly corroded, from the attention of the furry tenants it had housed over the years. Many of these connectors were so far gone that they had to be replaced.

Eventually we had the upper manual working as good as new and there was no hum. (The source of the hum was never found but was probably due to one of the edge connectors, as Mr Pierce found in his organ.)

There was one circuit card missing completely, and I worked out that this must have been a mixer for the lower manual and foot pedals, among other things. I was able to sort out which were the inputs and outputs to this board, and made up a temporary circuit to fill the gap.

Now my wife can enjoy playing a theatre type organ in our home, one with most of its functions working properly. There were a lot more connections to the missing board which I can only guess at, and I would like to obtain a circuit for it so I can restore some of the missing features.

Mr Pierce must have a circuit manual for his organ and if I could write to him, he may be able to give me a photocopy of this particular board. The power supply circuit reproduced in EA is very similar to mine, the main difference being that mine has a 240V power transformer whereas the diagram in EA shows a 120V transformer.

I hope that you can help me.

Yours faithfully,

Keith Vieritz.

As you can see, Keith's letter not only asks for information but also tells of an interesting restoration that we might follow up in the future.

It's our policy not to give out the addresses of contributors without their permission. As in this case, we pass a copy of the letter to the contributor and leave it up to him to contact the writer. If the contributor does not wish to pursue the matter, then that will have to be the end of it. However, in this case, we've heard that Walter Pierce has agreed to help Mr Vieritz and the outcome may well be a continuation of the story given so far. Keep watching.

And the answer is...

Now finally, the cause of all that trouble with the NEC television. It was an open-circuit base feed resistor (470k 1/2W) between the HT rail and the base of the chopper transistor inside the flat pack. Without this resistor to supply an initial bias, the power supply can never get started.

A similar resistor, or sometimes two resistors in series, appears in many different self-oscillating switch mode power supplies. And because the resistor just sits there with 330V across it while ever the power switch is on, even in standby mode, it eventually fails and goes open circuit.

The clue is the filter capacitor with a full charge, even after the power is off and the AC plug pulled from the wall socket. This capacitor can only remain fully charged if the chopper transistor is turned off, and the most likely reason for this is a lack of base drive.

An unusual feature of this fault is that the resistor can go open at any time while the set is working, and it will keep on working. In this situation the chopper base drive is being supplied by the feedback winding in the transformer. However, once the set is turned off, it can never get going again because the startup bias must be supplied through the now-open resistor.

Did you work that one out? It's such a simple fault that it is quite easy to overlook. We tend to think that anything as dramatic as a total failure has to have a complicated cause, and many quite competent technicians will go on looking for a difficult fault when none exists. ❖

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- BONUS 7 FREE CD SOFTWARE TITLES; MS Works & Money/ Encarta 97/ Golf/ CD Sampler / 3D Movie Maker, Cinemania 97, MS Scenes on disk & Yellow & White Pages on CD-ROM.
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PAY ONLY $2695 TAX INC

or *Smartrent it for **$25.95** per week over 36 months

If you are considering this system for your business, we have a smarter way! Simply *SmartRent it for **$25.95** per week over 36 months & get 100% tax deductiblility*. TAP.

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Now Available!

Comes complete with Windows/DOS installation disk and one zip disk with zip tools software! C11901

$199

BLANK CD-ROM DISKS

PRODUCE YOUR OWN CDs!

	1-9	10+	100+
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6X Reading Speed, 2X speed Writing

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- 100MB Zip disks hold all your stuff • Are inexpensive, reliable and ready to help you get organized • Use as many disks as you need

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Available for IBM and Mac

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***PLUS* 50 hours FREE Internet Access** - (Conditions Apply)

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USRobotics Sportster Flash 56.6Kbps External Fax Modem

with personal voice mail and hands free telephone capability Sportster Flash provides you with a complete communication device for your home or office.

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T90020 ..... **$5.95**

BF-998 DUAL GATE MOSFET

T90291 ..... **$4.95**

To suit Low Cost RF Test Oscillator Kit (EA May 96)

BS-170 60V 300mA TO-92 V-MOSFET

T90794 ..... **$1.45**

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NEW LOWER PRICES

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DC 12V. For 486 CPUs.

1-9	10-25	100+
$8.00	$6.50	$5.25

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For Pentium/ 686 CPUs. With metallic clipfor Zif socket 5 or 7

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U10626 ..... **$1.95**

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U10627 ..... **$3.25**

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AD590J CURRENT OUTPUT TEMPERATURE TRANSDUCER

U20720 ..... **$12.95**

To suit Temperature Adaptor (Electronics Today International)

MOSFET DRIVER

IR-2155 SELF-OSCILLATING HALF-BRIDGE MOSFET DRIVER

U10650 ..... **$10.45**

IRF-610 200V 1A N-CHANNEL TO-220 MOSFET

U10815 ..... **$2.45**

*TO SUIT **K10875** .. TRANSCUTANEOUS ELECTRICAL STIMULATION SC AUG'97*

IC SPECIALS

OLD STOCK. WE HAVE TOO MANY, SO OUT THEY GO AT RIDICULOUS PRICES

Cat No.	NORMALLY	1-9	10-99
U21990 - 81LS95	$2.75	50¢	40¢
U10600 - LM301N OP AMP	$1.00	40¢	30¢
U11820 - NE567 Tone Decoder	$2.00	$1.00	80¢
Z14520 - 4520	$1.50	50¢	40¢
Z17006 - 7406	$1.00	20¢	15¢

AMPLIFIER TRANSISTORS

MJE-340 300V 500mA NPN TO-126 TRANSISTOR

T90420 ..... **$2.00**

MJE-350 300V 500mA PNP TO-220 TRANSISTOR

T90421 ..... **$2.00**

MJL-21193 250V 16A 200WATT PNP TOP-3 TRANSISTOR

T90435 ..... **$9.95**

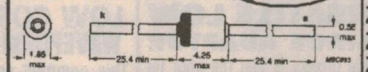
MJL-21194 250V 16A 200WATT NPN TOP-3 TRANSISTOR

T90436 ..... **$9.95**

To suit 500-Watt Audio Amplifier (SC Aug'97)

FAST RECTIFYING DIODE

75V 200mA Z10102 **30¢**

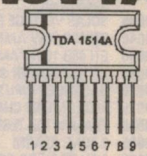


OP505D T1/3 PHOTO TRANSISTOR $4.65

Half Angle: 16°
Response: 5
Peak Response: 840mm
Sensitivity: 4.0 (min) @ 20mW/cm²

TDA 1514A

A very high quality audio amplifier in a 9-pin flat package. The amplifier will deliver 40W into a 8Ω load with ±21.5V power rail. With overload protection and is designed to meet the requirements of digital sound sources such as compact disc or car stereos.



1. Non-inverting input (#1)
2. SOAR
3. Mute
4. -ve
5. Output
6. +ve
7. Bootstrap
8. 0V Non-inverting input (#2)
9. Inverting Input

U10183

1-9	10+
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HIGH VOLTAGE CAPACITORS

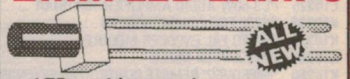
100 uF 100V PCB ELECTROLYTIC CAPACITOR RB

R15536 ..... **$1.25**

150uF (0.15(F) 630V MKT POLYCARBONATE CAPACITOR

R16140 ..... **$3.25**

2MM LED LAMPS



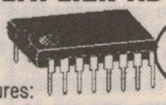
LEDs subject to change

Cat No.	COLOUR	WAVE LENGTH	LUMINOUS INSTENSITY mcd
Z10185	RED	700	0.5-12.5
Z10186	GREEN	565	3.2-8.0
Z10187	YELLOW	590	3.2-8.0
Z10188	ORANGE	625	12.5-32.0

FOR "TRAFFIC LIGHTS FOR AN INTERSECTION" KIT No. K10835

1 .....30¢
10+ .....25¢
100+ ...22¢

LOW COST ANALOG MULTIPLIER AD633 NEW!



U20030 **$11.95**

Features:

- Four-Quadrant Multiplication
- Low cost 8-pin package
- Complete-no external components required
- Laser-trimmed accuracy and stability
- Total error within 2% of FS
- Differential high impedance X and Y inputs
- Laser-trimmed 10V scaling reference

APPLICATIONS:

- Multiplication, Division, Squaring
- Modulation/ Demodulation, Phase detection
- Voltage-controlled amplifiers. Attenuators/ Filters

The AD633 is a functionally complete, four-quadrant, analog multiplier. It includes impedance, differential X and Y inputs and a high temperature summing input (Z). The low impedance output voltage is a nominal 10V full scale provided by a buried Zener. The AD633 is the first product to offer these features in a modestly priced 8-pin plastic DIP and SOIC packages.

*TO SUIT **K10860** VERSATILE LOW VOLTAGE ADAPTOR EA AUG'97*

NEW ENTRY LEVEL 4 COLOUR COLOUR INKJET PRINTER FROM EPSON!

ALL NEW!

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Brilliant New Ink Requirement Concept:

- Uses **only 1 ink cartridge** for 4 colour: Black, Cyan, Magenta & Yellow.

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High quality output features:

- Print speeds up to 3ppm* in monochrome and 1.2ppm* in colour.
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- Built-in sheet feeder holds up to 100 sheets.
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- Bi-directional parallel standard.

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- 12 months warranty for total peace of mind.

**Print speed is only a guide. May vary under different conditions*

$246 C92440

$295 TAX INC

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CD-ROMS PACKED WITH EVERYTHING YOU HAVE EVER WANTED TO KNOW ABOUT ELECTRONICS-BUT DIDN'T DARE ASK!

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Great for students learning Electronics, for Electronics Hobbyist or even for Technicians to further enhance their electronics knowledge! Packed with heaps of Utilities & Software

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EMP1047

2.5" & 3.5" REMOVABLE HDD CARRIER

REMOVABLE-2.5" & 3.5" H.D.D. FRAME

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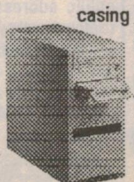
This frame suits 2.5" or 3.5" hard disk drives format and will fit into any computer casing from Tower to Desktop models. Great for exchanging data with other system or expanding your system capability to work with more data without the need for lengthy hdd installation. Simply connect another hard drive to this carrier.



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K10105	3 DIGIT COUNTER	$22.95
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K10166	240VAC TRIAC TRIGGER (SHORT FORM)	$59.95
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K10805	POCKET SIZED "MINIOSC" AUDIO OSCILLATOR	$45.25
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*AVAILABLE SOON

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PHONE CONTROLLED REMOTE POWER SWITCH

When connected to a modem, this low-cost project will activate its 240V AC outlet when a pre-determined number of rings occur on the phone line. Dubbed the Remote Power-up, it's ideal for communication sessions between PCs where the remote "host" is normally off- a far more secure way to leave an unattended PC and its valuable data. The unit has an automatic or manual shut-off feature, is easy to build common off-the-shelf parts, and can be used for a range of other remote power control tasks. ***Jumper box is included. EA JUN'97***

K10845 $64.95 ALL NEW

VERSATILE LOW VOLTAGE ADAPTOR

This little project is just the shot for those occasions where a low-voltage regulated DC source is needed from a small package. Based on a robust but low-cost regulator IC, the adaptor uses push-on jumper links to preset the output voltage between 3V and 15V, and depending on the heatsink you use, can deliver an output current of up to 1.5 amps. You can use it to power external peripherals from a PC, or to run a personal CD player from a car's cigarette lighter socket. ***EA Aug'97***

K10860 $8.45 ALL NEW!

LOW COST SIMPLE WAVEFORM GENERATOR

This compact unit produces both square and triangle waves over the frequency range from 100Hz to 20KHz. Build it and use it to test audio amplifiers, filters, tone decoders and digital circuits. ***SC Jul '97***

K10855 $21.25 ALL NEW!

INTERIOR LIGHT DELAY FOR VEHICLES

ALL NEW!

Fit this project to your car and the courtesy lights will stay on for an extended period after the door is closed, then fade out gracefully. It's small, low in cost, can be installed without cutting any existing wires, and can be configured to suit virtually any cars. ***EA APR'97***

K10830 $8.45

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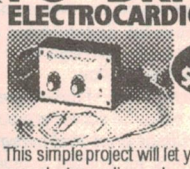

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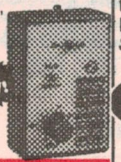

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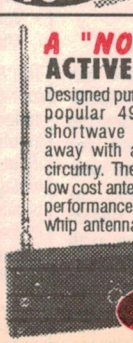

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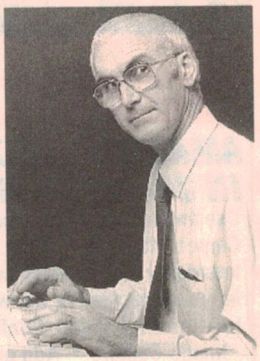


Yet another report that supposedly shows EM fields pose no health risk...

Since we last looked at the vexed question of EM fields and their possible health risks, there's been yet another research report from the USA which has been widely touted as 'proving that there's no problem'. However like the NAS/NRC Report we considered back in February, the new NCI/CCG report seems to have raised more questions than it answers. In fact, as many critics have already pointed out, about the only thing it DOESN'T prove is that EM fields are totally benign!

The new report was published in the July 3 issue of the *New England Journal of Medicine*. It presented the results of a study carried out by the National Cancer Institute (NCI) and the Children's Cancer Group (CCG), headed by Dr Martha S. Linet, investigating the possibility of any links between magnetic fields due to power transmission lines and the incidence of acute lymphoblastic leukemia (ALL) in children.

Perhaps the quickest way to give you not only a better idea of the gist of the Linet report, but also the way its results were presented to the general media, is to reproduce here the NCI's official press release:

STUDY FINDS MAGNETIC FIELDS DO NOT RAISE CHILDREN'S LEUKEMIA RISK

A comprehensive study by researchers from the National Cancer Institute (NCI) and the Children's Cancer Group (CCG) found no evidence that magnetic fields (EMFs) in the home increase the risk for the most common form of childhood cancer.

In this case-control study, the researchers found that, in general, children who lived in homes with high measured magnetic fields were not significantly more likely to be diagnosed with acute lymphoblastic leukemia (ALL) than children living in homes with lower magnetic field levels. Nor was ALL found to be more likely among those whose homes were classified in high categories of 'wire-code', a surrogate measure of magnetic fields that is based on the thickness, configuration, and distance from the home of nearby power lines.

"The results of our study differ from three earlier US studies, in that we found no evidence of a significantly increased risk of ALL among children whose main residence or residence during pregnancy was classified in the highest wire code category", said lead investigator Martha S. Linet, M.D., of NCI's Radiation Epidemiology Branch. The results are published in the July 3 issue of the New England Journal of Medicine.

Whether power frequency magnetic field exposures (EMFs) may increase cancer risk has been a controversial question, and nearly two decades of research has produced conflicting results. EMFs exist naturally inside the human body and in the surrounding environment, but stronger fields are produced by power lines and electric appliances, which have been the focus of most research. Recent research has focused on magnetic fields, specifically the 60 cycle-per-second (60 hertz) fields produced by alternating current (AC) in household electrical power.

The first study to suggest a risk from magnetic fields was published in 1979, when researchers reported that children who had died from leukemia or other cancers were about two to three times more likely than other children to have lived within 40 metres of a high-current power line. Several other groups of investigators later described similar findings based on proximity to power lines. When researchers have actually measured magnetic fields in children's homes, however, they have not found significantly increased risks of leukemia or other cancers.

Previous studies on magnetic fields and childhood cancer have had one or more shortcomings that make interpretation of their results difficult. These include small numbers of leukemia cases, measurements limited to a single residence, long intervals between leukemia diagnosis and magnetic field measurement, and data collectors aware of which children had leukemia (cases) and which did not (controls).

The NCI/CCG researchers designed their study to overcome these limitations as much as possible. A large study population covering nine states was chosen, and measurement technicians were unaware of case or control status. For most subjects, measurements were made within two years after diagnosis, and were obtained in both current and former residences. The measurements covered homes in which the child had lived for at least 70% of his or her life, or 70% of the five years immediately before diagnosis for children age five and older.

The researchers compared magnetic field exposures of 638 children with leukemia and 620 children without leukemia who were similar in age and race. About 58% of the children were under age 5, the age group in which ALL is most common. The participants lived in Illinois, Indiana, Iowa, Michigan, Minnesota, New Jersey, Ohio, Pennsylvania, and Wisconsin.

The researchers estimated magnetic field exposures in two different ways: by measuring fields in current and former homes of the children (including homes their mothers lived in during the pregnancy) and by assigning wire codes to the homes. Slightly less than half of all subjects had summary residential magnetic levels less than 0.065 microtesla (uT), close to 20% had levels ranging from 0.065 to 0.099uT, 23% had levels ranging from 0.100 to 0.199uT, and the remaining 12% had levels of 0.200uT or higher.

If magnetic fields increased risk for ALL, the researchers would expect that the higher the measured level of mag-

netic fields in homes, and the higher the wire code category, the more ALL cases they would find. But in general, they did not see either of these patterns. For children living in homes with magnetic fields measured at 0.2uT or above, the researchers calculated a slightly elevated, but not statistically significant risk for ALL compared with risk for children living in homes with magnetic fields below 0.065uT. While risk of ALL appeared to be slightly higher among children residing in homes with high levels, the absence of a consistent pattern of increasing risk with increasing exposure level suggests that the slight increase seen could be due to chance.

In addition, the researchers found no relationship between wire code classification and risk for ALL. Children with ALL were no more likely than controls to live in homes with high wire-code classification.

The researchers also interviewed mothers of case and control children about the children's electrical appliance use and the mothers' appliance use during pregnancy. Results from this part of the study are still being analyzed and are expected to be published separately in 1998.

"This important study would not have been possible without the close collaboration and committment of the physicians, nurses, and researchers of the Children's Cancer Group, and the cooperation of the families who participated", said Leslie L. Robison PhD, a co-investigator in the study and professor of pediatrics at the University of Minnesota, Minneapolis. The Children's Cancer Group is a multicentre network of pediatric oncologists and other researchers from 38 institutions and affiliated hospitals who diagnose and treat approximately 50% of children with cancer in the United States.

The NCI/CCG study is part of a larger CCG investigation of ALL comprising more than 1900 ALL cases and 1900 controls. The larger study, overseen by Dr Robison, is designed to evaluate the risk of ALL associated with a wide range of factors, including maternal diseases and medication use during pregnancy, childhood diseases, and other exposures such as parental occupation. Results are expected within the next two years.

OK, so that was the way the research results were announced to the world at large. By the way, you've probably noticed that the field strengths given are in microteslas (uT), whereas a lot of other EMF/health studies have given their findings using the older units of milligauss (mG). It's not all that difficult to convert between the two, though: 1uT is basically the same as 10mG.

You may care to note also that copies of the NCI report are apparently available by writing to Dr M. Linet at the Division of Cancer Epidemiology and Genetics, National Cancer Institute, Executive Plaza North, Suite 408, Bethesda MD 20892-7362, USA.

Spate of stories

Not surprisingly, many of the daily printed and electronic media around the world picked up on the report, and there were a spate of stories proclaiming that the NCI/Linet study had finally 'proved that fears about children developing leukemia from living near high-voltage power lines were groundless'. In part these reactions seem to have been prompted not just by the report itself, but by an accompanying editorial in the same issue of the *New England Journal of Medicine*, written by Dr Edward W. Campion. As the time of writing this, you can download this editorial from the web by going to the URL **http://www.nejm.org**, linking to the past issue for July 3, 1997 (Vol. 337,

No.1) and clicking on the editorial link titled 'Power Lines, Cancer and Fear'.

But although a lot of the media seemed to accept the supposed findings of the NCI/Linet study at face value, it didn't take long — just a few days, in fact — before those who looked a little closer at the actual published results came up with some surprises. It turned out that rather than supporting the 'EMFs pose no leukemia risk' argument, some of the results actually showed that there WAS a statistically significant risk!

The resulting 'wait a minute' reaction was quite neatly summarised by a statement issued a couple of days later by our old friend Don Maisch, who runs the EMFacts Information Service down in Hobart. Here's what Don had to say:

The NCI Study: Putting a Spin on Science

On Friday July 4, 1997, both The Australian and The Sydney Morning Herald featured articles about the just released US National Cancer Institute study which found that there was no evidence that powerline electromagnetic fields increase childhood leukemia risks. This study was published July 3rd in the New England Journal of Medicine. Most of the media and power industry supporters are claiming this study exonerates powerline EMFs as a health hazard. These claims cannot be scientifically justified, as the following will illustrate.

Don MacPhee from LaTrobe University's school of microbiology states in The Australian that the results of the NCI Study backed his claims that power lines did not emit enough energy to cause childhood cancer or any other form of cancer. MacPhee said that it was mostly the media and scientists of 'dubious quality' that had perpetuated the myth that there was any link between power lines and cancer. "It's just absolute nonsense", Dr McPhee said.

This line is also being actively pushed by the media in the US and is being promoted as proof that future funding for research should cease.

It is unfortunate that reporters and so-called experts who are now calling the NCI study as positive proof that a risk does not exist from long-term exposure to powerline electromagnetic fields did not take the time to critically examine what the study actually found, and to examine the criteria which led to the NCI researcher's conclusions.

The researchers actually acknowledge in no less than four places, a statistically significant increase in acute lymphoblastic leukaemia (ALL) in children exposed to powerline magnetic fields in excess of 3 milligauss, finding almost twice (1.79) times the number of expected cases. This is a CONFIRMATION of many previous studies which have shown a similar level of association between childhood leukaemia and magnetic fields from electricity. The article in The Australian mentions that the researchers dismissed as a 'statistical fluke' a 24% increase in leukemia risk for children exposed to what is termed 'especially high magnetic fields'.

The NCI researchers were able to dismiss this fact by arbitrarily setting a 2mG level as a cutoff limit. The fact is, that if they had used the 3mG level as a cutoff point in their calculations, the conclusions would have been exactly the opposite — that there is a significant risk.

On July 4th, EMFacts e-mailed Professor Ross Adey, one of the most respected bio-electromagnetic researchers in the US. Dr Adey is the author of numerous books and research papers on the bio-effects of EMFs. He recently conducted a $3 million research program for Motorola. His reply on the NCI study is as follows:

'A number of us worked on the NCI paper through last weekend. Sam Milham, the Washington State epidemiologist and a pioneer in this field, points out that if they had included the 3mG level in their cutoff, the conclusions would have been exactly the opposite — that there IS a significant risk. And selection of 2mG is quite arbitrary. David Savitz used 3mG in some of his work. Obviously there is no steep threshold beyond which risks rise exponentially.'

'At the recent Bologna International Symposium, Schuz from U. Mainz had a paper combining kids from Berlin and Southern Saxony in high exposure homes to give leukemia odds ratio of 6.8 for young kids (under 4yrs). So the dismissive attitude of NCI is totally unrealistic.'

'Richard Stevens, the epidemiologist from Battelle and editor of the recent melatonin/breast cancer book, has written a rebuttal letter to the NEJM.'

Don Maisch himself continues:

Surprisingly, for a modern study, the NCI researchers only measured MAGNETIC fields and did NOT include ELECTRIC fields, which are being increasingly implicated in cancer development and many other adverse health conditions. Both magnetic and electric fields are being measured in the landmark UK Childhood Cancer Study due out early next year, as UK researchers understand the potential importance of electric fields.

In the 1996 Ontario Hydro adult worker study conducted by Dr Antony Miller of Toronto University in Canada, when they took both fields into account the risk rose from 1.6 (magnetic fields only, and similar to the 1.79 in this study) to 11.2 (both magnetic and electric fields considered). It is likely to be a similar increase for children.

If we extrapolate to the evidence (Electromagnetics Forum, Vol.1, No.2 pp.5-6) that levels of 12mG affect the ability of melatonin to suppress cancer cells and that there is some evidence of a dose-response relationship between 2 and 12mG, then at levels at or below 2mG, a 'no effect' result could well be expected.

With this in mind, the only thing the NCI indicates is that children with magnetic field exposures at 2mG and under are not at increased risk of developing leukemia from their EMF exposure.

According to Alasdair Philips, co-author of the study 'Extra low frequency electric and magnetic fields in the bedplace of children diagnosed with leukemia: a case-control study', published in the June 1996 volume of the European Journal of Cancer Prevention, it is common to find levels above 3mG near to power lines, electricity substations and in many city houses.

Rather than exonerating EMFs, the NCI study gives further support for the 1995 draft guidelines from the US National Council of Radiation Protection and Measurements. (NCRP) These guidelines generally endorse a 2mG exposure limit.

As stated in the NCRP's conclusions:

'In arriving at the proposed guidelines, the committee has considered available laboratory studies on bioeffects and epidemiological reports of health hazards from electric and magnetic field exposure. ...In key areas of bioelectromagnetic research, findings are sufficiently consistent and form a sufficiently coherent picture to suggest plausible connections between ELF EMF exposures and disruption of normal biological processes, in ways meriting detailed examination of potential implications in human health.'

What was surprisingly NOT reported in the Australian media was the release of a much larger Swedish EMF human exposure study less than three weeks before the NCI study. The Swedish study included approximately 400,000 subjects who had lived within 300 metres of transmission lines in Sweden for at least one year between 1960 and 1985. The researchers found that persons who were exposed to magnetic fields both at home and at work are nearly four times more likely to develop leukemia than those who were not exposed to magnetic fields.

To quote from the Epidemiology Press Release of 16 June 1997, entitled 'Exposure to Magnetic Fields at Home and at Work Increases Risk of Leukemia':

'Dr Maria Feychting and colleagues at the Karolinska Institute and the National Institute for Working Life in Sweden report in the July issue of Epidemiology that persons who were exposed to magnetic fields both at home and at work are nearly four times as likely to develop leukemia as those who were not exposed to magnetic fields.'

'Dr Feychting and colleagues conducted a case-control study from among approximately 400,000 subjects who had lived within 300 metres of transmission lines in Sweden for at least one year between 1960 and 1985. The investigators designated as cases 325 residents diagnosed with leukemia and 223 residents diagnosed with a tumour of the central nervous system. For each case identified, they selected at random at least two control subjects of the same sex and five-year age group who had lived in the same parish as the case.'

'They assessed exposure to magnetic fields generated by transmission and distribution power lines close to each subject's house, excluding buried power cables from the calculations. They obtained information on each subject's occupation from five-year censuses. They assessed occupational magnetic field exposures for each subject, through extrapolation of exposure estimates for each occupation and without knowledge of whether the subject was a case or control.'

'The investigators took into account in their analysis other occupational exposures, such as benzines, oil products, solvents, and welding fumes, that have been associated with leukemia in earlier studies. They compare the residential and occupational histories of the cases with the histories of controls. Subjects in the highest category of occupational exposure to magnetic fields (0.20uT) had nearly double the risk of developing acute myeloid leukemia, a 40% increase in risk of developing chronic myeloid leukemia, and a 70% increase in risk for chronic lymphocytic leukemia when compared with unexposed subjects. Those with high levels of exposure to magnetic fields at home had double the risk of developing acute myeloid leukemia and chronic myeloid leukemia as those who were unexposed.'

'Among subjects who had high exposures to magnetic fields at home and at work, the risk of developing acute myeloid leukemia and chronic myeloid leukemia increased more than six fold and doubled for chronic lymphocytic leukemia when compared with subjects who had not been exposed to magnetic fields. Results for central nervous system tumours were consistent with no increase in risk.'

Don Maisch summarises:

One possible reason why the Swedish study was not reported and the NCI was, is suggested by the Report of the Panel on Electromagnetic Fields and Health to the Victorian Government, September 1992:

'To date the responsibility for communicating with the community about ELF fields has rarely been clearly defined and most information is developed and disseminated by the utilities, as health authorities have not considered ELF fields as an important health matter.'

My thanks to Don Maisch for allowing us to use this statement, which I think you'll agree puts a rather different slant on what conclusions should be drawn from the NCI/Linet study. By the way, you can usually find more helpful info about EMF/health issues on Don's home page at **http://www.tassie.net.au/emfacts/**.

FORUM

Researchers' concern

To drive home the point that Don was making, here's the text of a press release issued on July 15 by three researchers attending the World Conference on Breast Cancer, in Kingston Ontario:

The recent report in the New England Journal of Medicine by Linet and colleagues has been widely reported as showing no link between exposure to electromagnetic fields (EMF) and one type of leukemia in children. On the basis of this new study, some scientists and some news media organizations, including the major networks, have repeated the questionable claim that the link between EMF exposure and cancer risk is no longer an issue, and that further research is unnecessary.

Such statements, based on a single study, are troubling. More disturbing still is the fact that the data presented in the Linet study do not support the assertion that no link exists. Even a cursory review of the main data set shows a 53% increase in leukemia incidence at magnetic field exposure levels above 2mG; a 72% increase (which is statistically significant) above 3mG, and a more than 600% increase at exposures of between 4 and 5mG. Above 5mG, no link is shown, but there are too few cases in this range to yield any significant result.

Dr Bary Wilson, who has co-authored a recent book on EMF and breast cancer, and several other speakers at the World Conference on Breast Cancer, including Dr Kjell Hansson Mild of National Institute of Working Life in Sweden, have stated that a study which is apparently positive and limited only to leukemia should not be used to discount a possible link between EMF and cancer in its entirety.

Any statement claiming the demise of the EMF and cancer issue should be based on an analysis of all the available data and not one study, particularly one in which the reported data are apparently not reflected in the conclusions. In fact available data on the subject, provided by many scientists over more than a decade, do not support the hypothesis that there is no link between EMF exposure and increased risk for several types of cancer.

Cindy Sage of Sage Associates and Chair of the EMF program at the conference points out that "even a small increased risk of breast cancer due to EMF exposure has enormous public health implications, given the high incidence of this disease in developed countries."

Based on the Linet, et al. study, it is clearly not justified to call for the end of research into the possible link between EMF and cancer. Given the growing body of evidence for a possible link between EMF and breast cancer, in particular, cessation of research funding at this time would be reckless and scientifically indefensible.

***Kjell Hansson Mild, PhD,** National Inst for Working Life, Sweden*

***Cindy Sage,** Sage Associates, USA*

***Bary W. Wilson, PhD,** Pacific Northwest National Laboratory, USA*

I don't know about you, but I get the distinct feeling that if some people and organisations were hoping to use the NCI/Linet study to persuade us all that there are no health risks from low frequency EM fields, it hasn't worked terribly well. What do you think? ❖

SMPTE Sydney '97

(Continued from page 19)

aggressive.

Recognising that disk-based technology for shooting and storage continues to be used, new trends were revealed by representatives from Hewlett-Packard, IBM, Quantel and Kodak.

Former Channel Seven exec Geoff Healy, as Head of Technical Operations and Engineering for Sydney's Olympic Broadcasting Organisation, chaired a guest panel discussion — disclosing 'tall tales and true from the Atlanta Olympic Games, and the big picture on the plans for Sydney'. On the final day the less-than glamorous process of getting the signal on air and out to an audience was covered by speakers from Avid Technology, Philips Broadcast, Sony and others.

Summarising

Overall, SMPTE 97 in Sydney as an event may have been less exciting than in former years, but much of the technology and talk gave strong indications of future trends. It seems likely that film and tape technology will still be there for a while, but they'll be accompanied by a healthy dash of digital to fill in the gaps. ❖

Experimenting with Electronics

by DARREN YATES, B.Sc.

CMOS circuits: The 4066 CMOS switch IC, part 2

This month, in our final part on CMOS circuits for the time being, we look at some more circuits using this very handy IC. You'll probably be surprised at just what it can be used for!

Last month, we looked at the basics of the 4066 CMOS analog switch; at how it works and what you can do with it. This time, we'll stretch our knowledge a little further by looking at some specific functions that can make use of this IC's particular capabilities.

Voice activated switch

If you've ever used a short-wave transceiver, then you'll probably have come across a voice activated switch or 'VOX'. The beauty of these things is that you don't have to listen to what sometimes can be endless hiss in the background. The trouble is that many of these voice operated circuits simply switch a relay in and out of circuit.

Our first circuit this month is a much more elegant solution using a couple of 4066 CMOS switches instead of the relay. It's faster and you don't get the 'bang' that often comes when the relay contacts close.

Looking at the circuit in Fig.1, it's fairly straightforward and uses common components. Sound is picked up with the electret microphone insert. These things are cheap, very handy and have quite a reasonable frequency response and sensitivity to boot. It's powered by the current from the 10kΩ limiting resistor.

The audio is AC coupled to a simple two-transistor preamplifier. This part of the circuit should look fairly familiar, as we've covered it a couple of times in previous circuits. The gain of this circuit is set by the ratio of the 10kΩ feedback and 330Ω bypass resistors, to around 34. The formula here is:

Gain = (Rx/Ry) + 1

The output, taken from across the 2.2kΩ collector resistor of transistor Q2, is split into two paths — one which creates the signal to control the switch, and the second the normal audio path.

Looking at the second one first, the audio is connected straight into one side of the switch IC1b. Note the two 100kΩ resistors connected across it. While it may look like there is an audio path here, all the audio is siphoned away by the 4.7uF bypass capacitor. The idea of the resistors is to create a DC path across the switch so that both sides have the same DC voltage. By doing this, we eliminate that annoying click when the switch opens or closes. It also simplifies the biasing of the switch, which is just the DC voltage at the collector of transistor Q2. And this is pretty much around half the supply rail — i.e., 4.5V DC.

The first path is a little trickier. The whole idea of this circuit is to make sure that when there is no significant audio coming through, the CMOS switch is open; and vice versa.

The first part of this path is through another amplifier, built around transistor Q3. This amplifies the daylights out of the signal, until hopefully it is 'clipping' or swinging to the limits of the supply rail. Diodes D1 and D2 then form a charge pump rectifier, turning our almost-square wave into a positive DC voltage, somewhat proportional to our input signal. So we now have our DC voltage to switch the switch on. The only problem is that the voltage across the capacitor isn't all that clean, and not really good enough to use on a CMOS input.

Transistor Q4 cleans this up some more, but it's now out of phase. So we use switch IC1a to invert the signal back in phase again, and now it's nice and clean ready for use. The final signal appears at the control input at pin 5 of IC1b.

The audio is then taken from the other side of IC1b and AC coupled to the output. From here you can take it to virtually any medium-impedance input.

Simple pulse generator

Our second circuit uses the CMOS switch in a more unusual design. It relies on the fact that the switch requires

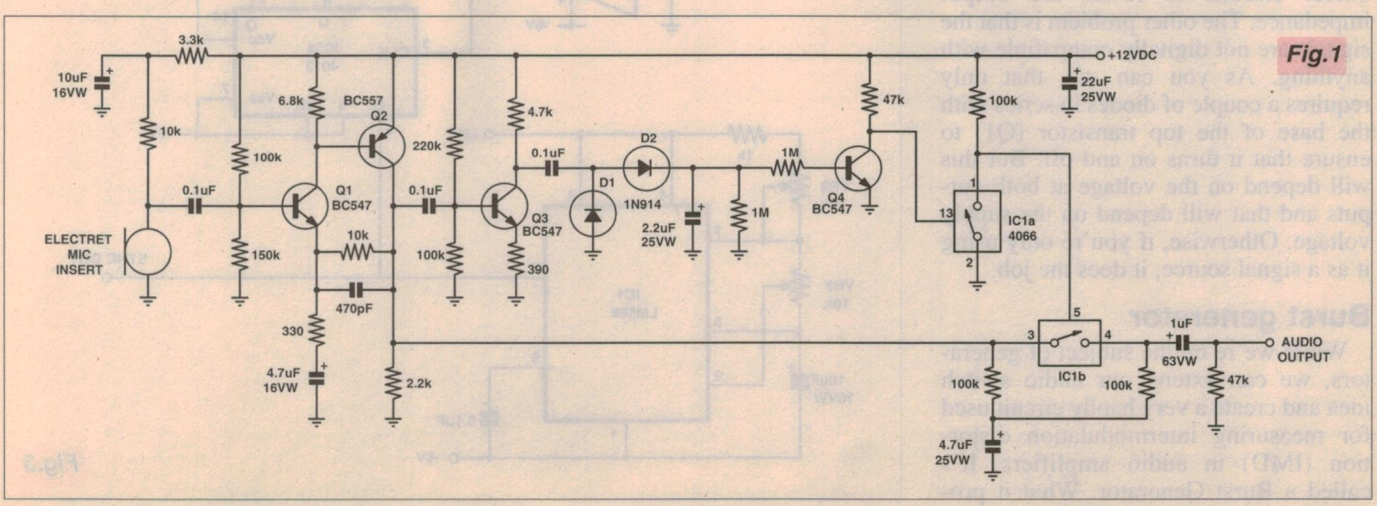


Fig.1

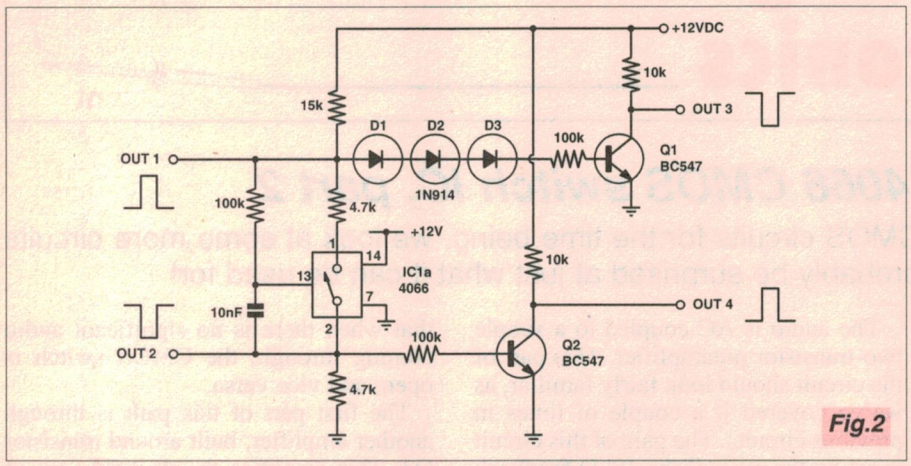


Fig.2

a certain voltage to appear at the control input before the switch will close. Let's take a look at Fig.2.

When the power is first applied, the 10nF capacitor begins charging up until it reaches the switch's threshold voltage, at which point it turns on. This now closes another circuit which begins to discharge the capacitor via the 100kΩ and 4.7kΩ resistors. However, at the same time, it jacks up the capacitor's voltage by about one volt, so it has to drop down to the switch's threshold voltage before it turns off. When it turns off, the DC voltage shifts again, this time to about one volt below the threshold level — by virtue of the 15kΩ and 4.7kΩ resistors connected to the supply rails.

This now means the capacitor now charges up to the threshold, and the switch turns on again. It's simple, and it also gives you two signals of equal frequency but out of phase — which can be very useful in other circuits.

Because each output is only medium-level impedance, you need to add in buffer circuits to lower the output impedance. The other problem is that the signals are not digitally compatible with anything. As you can see, that only requires a couple of diodes in series with the base of the top transistor (Q1) to ensure that it turns on and off. But this will depend on the voltage at both outputs and that will depend on the supply voltage. Otherwise, if you're only using it as a signal source, it does the job.

Burst generator

While we're on the subject of generators, we can extend our audio switch idea and create a very handy circuit used for measuring intermodulation distortion (IMD) in audio amplifiers. It's called a Burst Generator. What it produces is basically a waveform of one frequency, but with two amplitudes.

The circuit uses a sinewave signal source from another circuit. (We've looked at some simple sinewave generators already and though crude, these can be used to see how the circuit works, rather than being useable for real amplifier testing...)

Looking at Fig.3, this input signal is fed to two op-amps IC1a and IC1b. The output of IC1a feeds two 4066 switches, IC2a and then IC2b via a 20kΩ pot, while the output of IC1b is connected to the clock input of IC3a, half a 4013 dual-D flipflop.

The D input of IC3a comes from a 555 timer IC. This configuration may look a little strange, having the input signal drive the clock rather than the D input, but it ensures that the step in output amplitude always occurs at the same point in the sinewave waveform.

The output comes from the joint outputs of switches IC2a and IC2b. Both switches are controlled by the 555 timer via the two Q-outputs of IC3a. The amplitude of the signal on both switches determines the overall amplitude of each section of the burst waveform.

The sync pulse at the output of the 555 timer allows you to monitor the burst output as a steady image on a cathode-ray oscilloscope (CRO). The number of cycles in each part of the waveform is controlled by the pulse width information coming out of the 555 timer. Pots VR2 and VR3 set both the pulse width and frequency. Hook the circuit up to a CRO and you'll see what I mean.

This is a fairly specific and high-end circuit that will only be of use to those readers who understand about IMD and the testing of audio amplifiers. However, if you want an audio circuit which switches between two audio sources, simply disconnect the input to

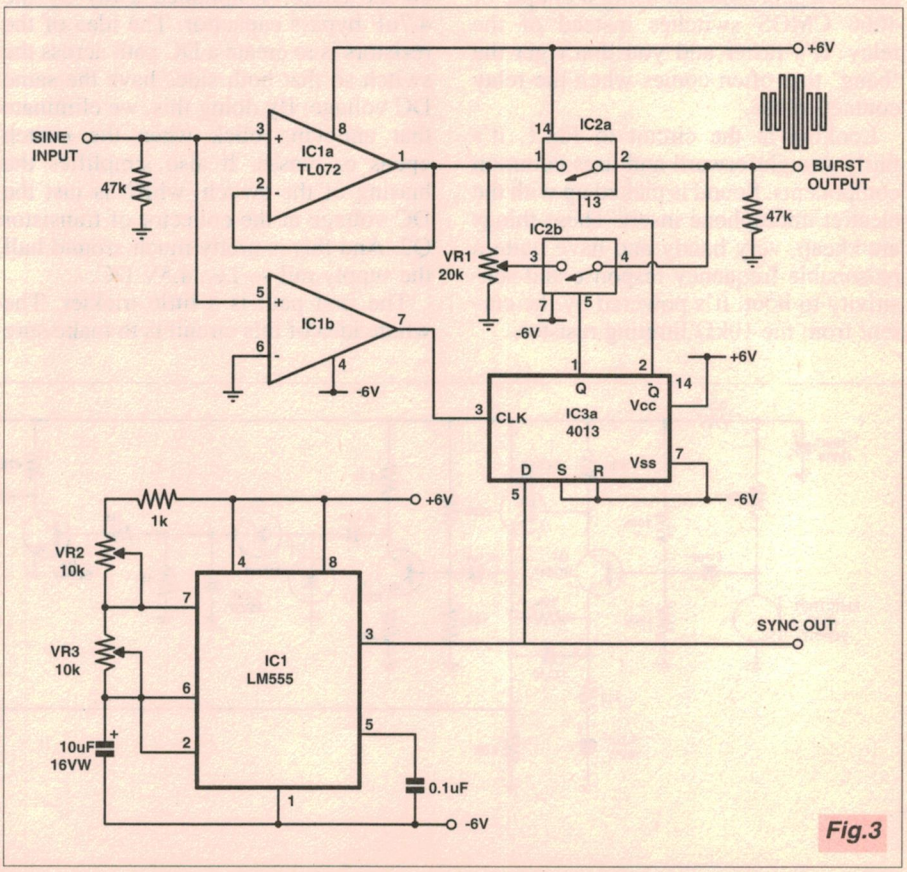
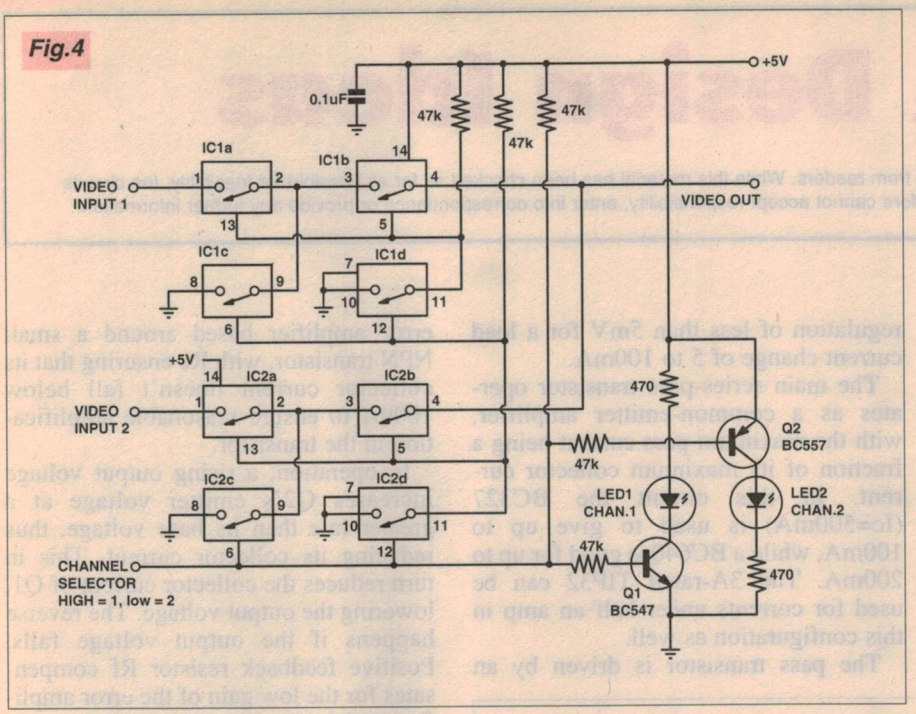


Fig.3

Fig.4



IC1b and double the input circuitry from IC1a and you've got a handy circuit for special audio effects.

Video selector

If you're into video editing, this little circuit will show you that the 4066 IC is versatile enough to be able to handle video signals. Looking at the circuit in Fig.4, it may look like a mass of 4066 switches but in operation, it's quite simple. By pulling the control input high, you receive the input from Channel 1; pull it low and you get the signal from Channel 2.

The reason for what appears to be so many switches is that the 4066 switches have a fairly high on-impedance of around 150Ω. So the possibility of what is known as 'cross talk' or images appearing in one channel from the other is quite possible.

The arrangement of switches is such that when the control input is high, Channel 2 is effectively open with pin 2 of IC2a shorted to ground (via IC2c), while Channel 1's input is connected to the output by virtue of the fact that switches IC1a and IC1b are closed. When the control input is taken low, switch IC2d acting as an inverter is now switched off, turning on IC1d (also used as an inverter) and allowing switches IC2a and IC2b to switch on.

It may look like a bit of a rabbit warren with each pair of switches controlling the next, but take your time and follow it through.

Now as with most circuits, there are some specific problems with this one — including a problem which shows up one of the limitations of the 4066.

Firstly, you'll notice that when you switch between video sources, the TV screen will roll until the following video circuitry locks onto the vertical sync pulses within the new video signal. It only takes a fraction of a second, but it's still noticeable. You don't see it on professional videos. This is a problem of the circuit rather than the 4066 chip. Circuits that remove this roll are much more complicated.

The other problem is directly caused by the 4066. Each switch has a turned-on impedance of around 150Ω, and this causes a drop in the signal level at the output, particularly when it's connected to the mandatory 75Ω input. This is the standard input and output impedance for all video circuits.

There are two ways around this problem. First, you could feed the signal through a video amplifier, to restore the level and lower the output impedance. Or you could connect additional switches in parallel with the switches that pass the video through. Paralleling the switches will drop the impedance to half — i.e. about 75Ω — which reduces the problem.

If on the other hand these problems don't worry you too much, then the circuit should work quite well for you.

Transistor replacement

This next circuit isn't exactly going to tax the brain too much, but it's a pretty handy reminder of the 4066's versatility. Last month, we looked at how the 4066 is pretty similar to an NPN transistor. What I neglected to do was to give you a couple of examples where this works in practice.

The circuit in Fig.5 is a perfect example in using the 4066 as an audio oscillator. The benefit here is that the equivalent base current required by the 4066 control input is far less than that of a transistor. It means that you can also obtain much lower frequencies than you could with a transistor as well. This circuit works well over a wide voltage range, from 3V to 15V without any hassles.

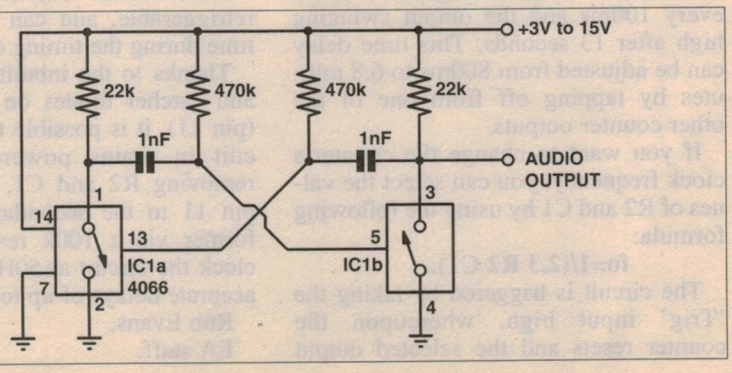
Unfortunately, the 4066 makes a lousy audio amplifier — it just has far too much gain to be able to control. Only a narrow voltage range somewhere near half the supply rail will toggle the switch between fully open and fully closed. As with other variations on this type of 'multivibrator' circuit, the frequency can be decreased by increasing the value of the two capacitors or the two control-input resistors and vice versa.

Resistor replacement

Our last main circuit for this month uses the 4066 in a fairly unusual way — as a voltage-controlled resistor. To understand this, think of a basic switch for a minute: when it's closed it has no resistance (in theory, anyway); when it's open it has infinite resistance. But what if we opened and closed the switch at a very fast rate?

Let's look at an example circuit in Fig.6. We have a CMOS switch in parallel with a 100kΩ resistor, making our 'super resistor'. If the switch is closed

Fig.5



Circuit & Design Ideas

Interesting original circuit ideas and design tips from readers. While this material has been checked as far as possible for feasibility, the circuits have not been built and tested by us. We therefore cannot accept responsibility, enter into correspondence or provide any further information.

Low dropout 5V regulator

This regulator has been designed to allow powering 5V circuits from a 9V battery. These batteries exhibit a gradual voltage drop through their life, from 9V down to 5.5V. Standard voltage regulators require a difference between input and output of around 2.5V, which means that the battery will have to be replaced while it still holds half its charge. This circuit gives a minimum dropout of 0.6V at 100mA, and a load regulation of less than 5mV for a load current change of 5 to 100mA.

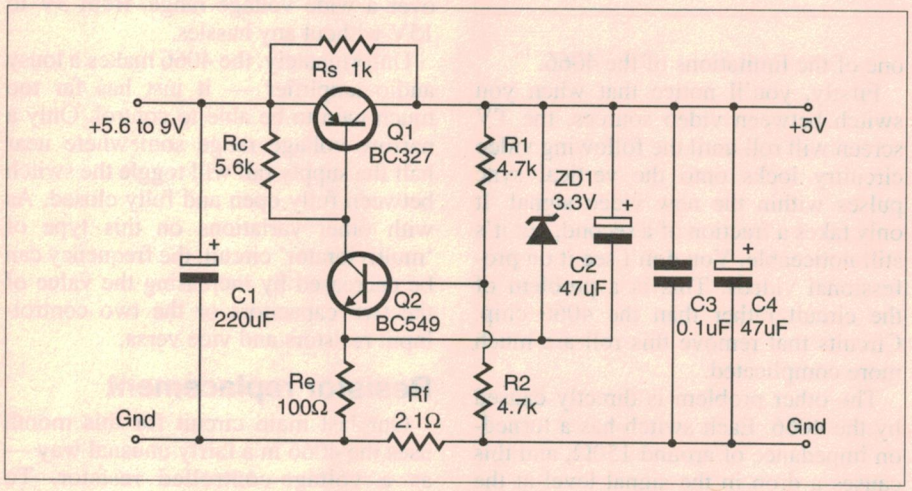
The main series-pass transistor operates as a common-emitter amplifier, with the maximum pass current being a fraction of its maximum collector current. In this circuit the BC327 (Ic=500mA) is used to give up to 100mA, while a BC640 is good for up to 200mA. The 3A-rated TIP32 can be used for currents under half an amp in this configuration as well.

The pass transistor is driven by an error amplifier based around a small NPN transistor, with Rc ensuring that its collector current doesn't fall below 100uA to ensure reasonable amplification in the transistor.

In operation, a rising output voltage increases Q2's emitter voltage at a greater rate than its base voltage, thus reducing its collector current. This in turn reduces the collector current of Q1, lowering the output voltage. The reverse happens if the output voltage falls. Positive feedback resistor Rf compensates for the low gain of the error amplifier, and for the losses in the Zener.

The values for Rs and Rf will have to be found empirically, With Rs being the minimum value that will let the regulator start up under full load, and Rf set so that the regulator exhibits a negative output resistance (i.e. an increase in output current gives an increase in output voltage.) To adjust the output voltage by a small amount, the values of R1 or R2 can be changed, but for large adjustments the value of the Zener should be altered along with R1, with the drop across R1 kept to around 1 - 2 volts.

Marcin Frankowski
Warszawa, Poland **$40**



Long duration one-shot

With the addition of a couple of extra components, the common 4060 binary counter can be turned into a monostable multivibrator, more often known as a one-shot. With the configuration shown, the counter's internal oscillator will run at 10Hz, resulting in one clock every 100ms and the output swinging high after 13 seconds. This time delay can be adjusted from 800ms to 6.8 minutes by tapping off from one of the other counter outputs.

If you want to change the counter's clock frequency, you can select the values of R2 and C1 by using the following formula:

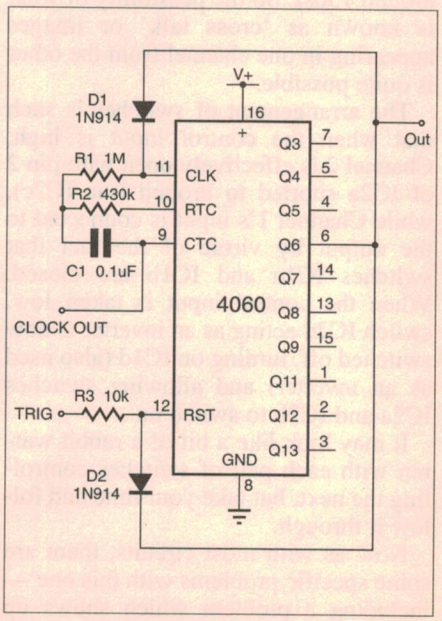
fo=1/(2.3 R2 C1).

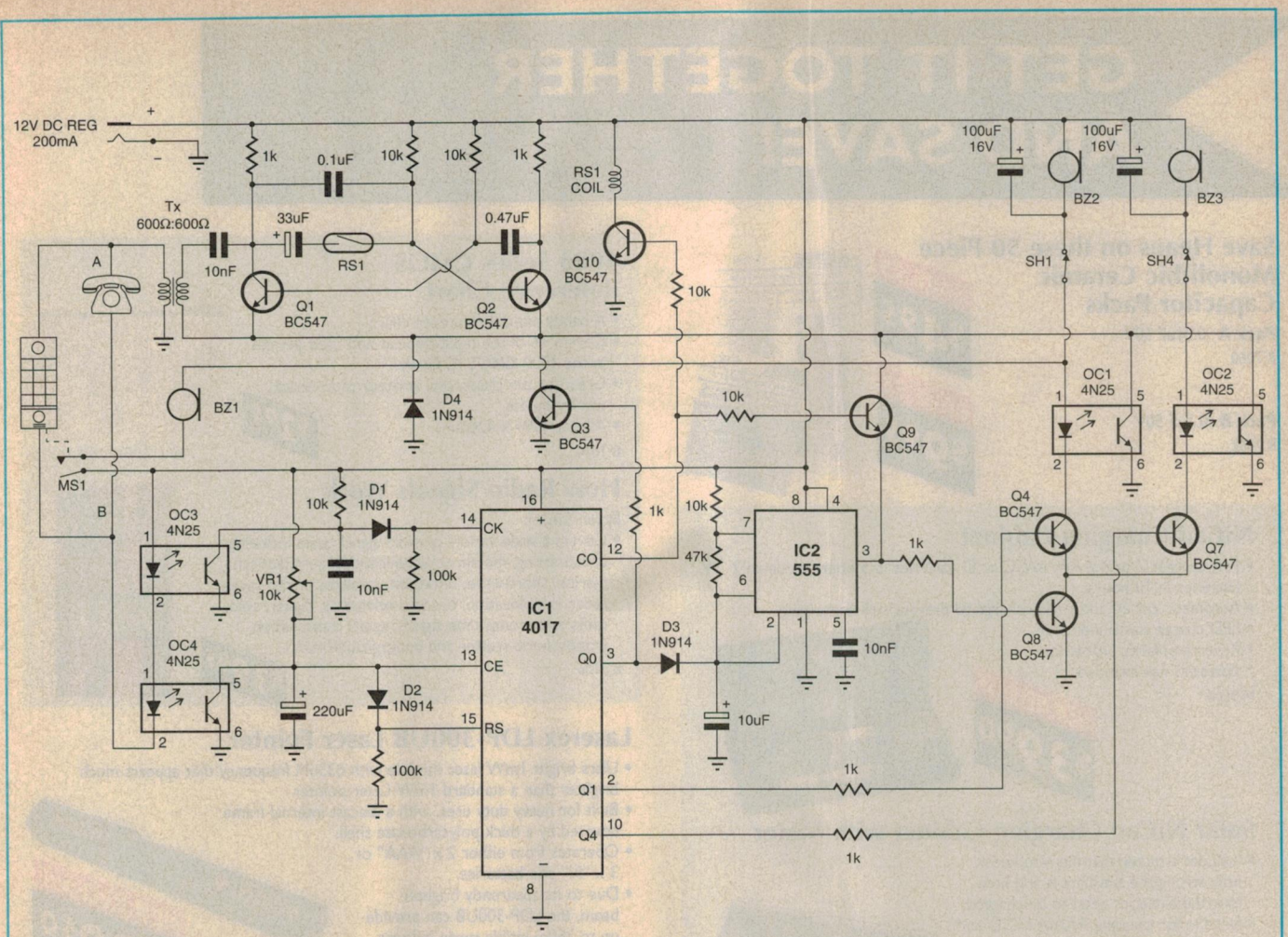
The circuit is triggered by taking the 'Trig' input high, whereupon the counter resets and the selected output goes low. This low prevents the counter from being reset during the timing period by the diode D2, resulting in a non-retriggerable one shot. As soon as the selected count goes high, D1 becomes forward biased and inhibits the clock, while D2 becomes reverse biased allowing the circuit to be triggered again.

If D2 is removed, the circuit becomes retriggerable, and can be reset at any time during the timing cycle.

Thanks to the inbuilt Schmitt trigger and catcher diodes on the CLK input (pin 11), it is possible to clock this circuit in mains powered projects by removing R2 and C1, and connecting pin 11 to the secondary of the transformer via a 100k resistor. This will clock the circuit at 50Hz, and will give accurate delays of up to 1.36 minutes.

Rob Evans,
EA staff.





Telephone intercom

This design lets you connect together two or more rotary or pulse dialling telephones to make an in-house intercom system. It is *not* to be connected to the public telephone system.

Calls are made by picking up the handset and dialling a one-digit number of the remote station. The circuit provides a dial tone, a ring tone and a busy tone, and only allows one call at a time to be made.

A DC loop is formed by one winding of the transformer, the dial phone (an old '800' series model) and the LEDs of the two optocouplers. When the phone is picked up, the loop is completed and the optocouplers OC3 and OC4 turn on. OC4 pulls pin 13 of IC1 low, enabling the chip, and pin 3 goes high — enabling the multivibrator based around Q1 and Q2. This produces a dial tone for the caller.

When the caller dials a number, OC3 acts as a buffer/pulse shaper and clocks IC1 the required number of times. Pin 3 goes low once the first pulse is received, and this turns off the dial tone until the next call.

As soon as pin 3 of IC1 goes low, the timer IC2 starts charging its 10uF capacitor and then begins to produce pulses on its output, pin 3. These pulses turn on the 9V buzzers inside the phone selected by the dialling operation.

For example, if we were to dial '4', then the decade counter's pin 10 would be high at the end of dialling, which would turn on Q7 and the LED inside OC2. Q7 would then turn on in unison with the pulses buffered by Q8, from IC2's output pin 3. At the same time, the phototransistor inside OC2 would be turning on and off as well, to enable the multivibrator based around Q1 and Q2, this time producing a ring tone for the caller to hear.

When the called party picks up the phone to answer, the switchhook inside the phone (SH1 or SH2) disconnects the buzzer, the LED inside OC2 has no path to conduct, and the phototransistor no longer enables Q1 and Q2 to produce a ring tone.

When the caller and the called party both hang up at the completion of the call, OC4 turns off, and pin 13 of IC1 goes high disabling the counter. This logic high is fed to the reset pin (15) of the IC, resetting the counter so that pin 3 is high. Timer IC2 now stops pulsing, waiting for the next call to be made.

Simon Laws
Ringwood, Vic. **$30** ❖

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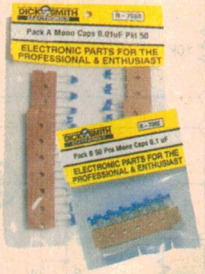

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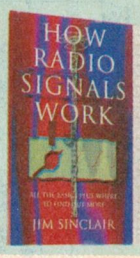

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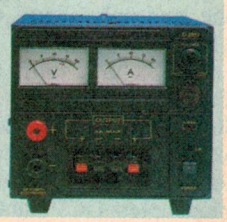

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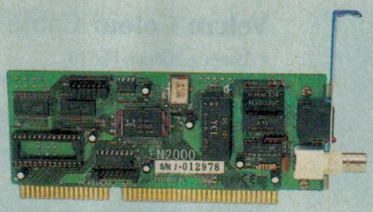

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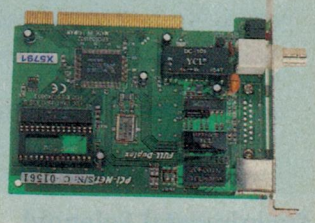

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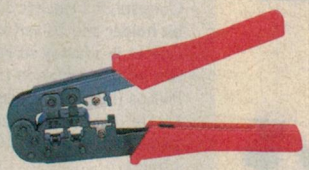

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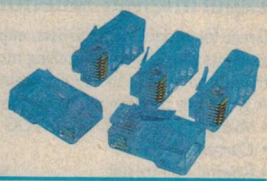

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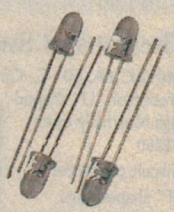

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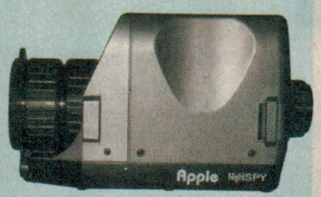

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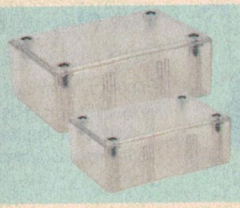

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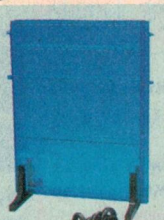

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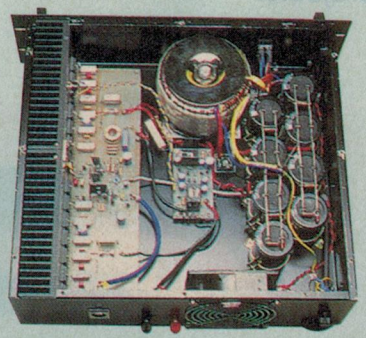

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Construction Project:

LASER-BASED RS-232 DATA TRANSCEIVER

Here's a project designed for the entry level laser experimenter. It allows any two computers with serial (RS-232) communication capability to communicate over a distance of up to 200 metres using a laser beam. A low cost transmitter-only circuit is also presented, for use in one-way communication and other laser based projects.

by GEORGE KATZ, BE

If you are like me and always wanted to buy a laser pointer to play with — but could never find practical uses for one — here are a couple of circuits to convince you to finally make that purchase. Before we begin, however, it is necessary to give a word of warning: **Never look directly into the laser beam, as eye damage may occur**.

I will present the project in two sections: the first is a full duplex transceiver, and the second is a transmitter only. The main reason for separating the designs is to offer a cheaper solution if only half duplex communication is required. For full duplex communication two transceivers and two lasers will be required, while for half duplex communication a single laser, a transmitter and a transceiver is needed. The transmitter can be also used as a standalone circuit if you only want to control the laser in other laser experiments.

The laser source for this project is an inexpensive laser pointer pen. As well as being readily available, the circuit is designed in such a way so that the laser pointer is not damaged, and can be used for other experiments. Because this is an entry level circuit, costs have been kept to a minimum — around $20 for the transceiver and approximately $10 for the transmitter (excluding the laser pointer).

Why use a laser? A laser as a communications medium has some unique properties compared to other forms of media. A line-of-sight laser beam is useful where wires cannot be physically connected to a remote location. A laser beam, unlike wires, also does not require special shielding over longer distances. Lasers offer reliable operation over distances at least an order of magnitude longer than infrared LEDs. Although RF transmitters may offer longer distances than line-of-sight lasers, they are subject to interference from other transmitters.

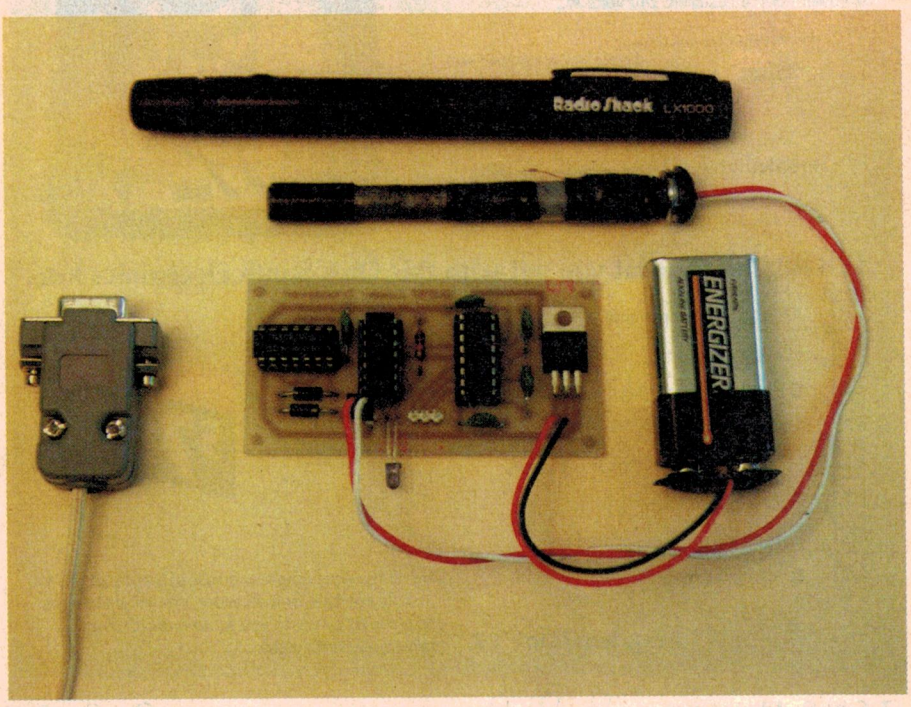


Fig.5: The assembled transceiver. In this photograph you can see the the 'dummy battery', used to reach the negative contact inside the case of the laser pointer.

Since the laser medium is line-of-sight and the beam is only several millimetres in diameter, it is very difficult for the data stream to be tapped. This offers secure communication since any attempts to intercept the laser beam would be detected at the receiver as a loss in data. A laser medium also allows for the sender and receiver to be galvanically isolated from each other.

The transceiver

The transceiver (Fig.1) is based on the MAX232A IC (U1), for generating and receiving RS-232 compatible voltage signals. The receiving sensor is an NPN infrared photo-transistor (OP505A). I chose an infrared photo-transistor to minimise ambient light interference. Although the laser wavelength is in the visible spectrum (around 670nm) the photo-transistor's broad response band (550nm to 1050nm) is wide enough to sense the intense laser beam.

The signal from the photo-transistor is buffered via a pair of Schmitt trigger buffers (U2a,b) to clean up and square the signal. The output of the second buffer is then directly converted to an RS-232 standard signal via the MAX232A.

The MAX232A generates +10V and -10V voltage swings using a dual

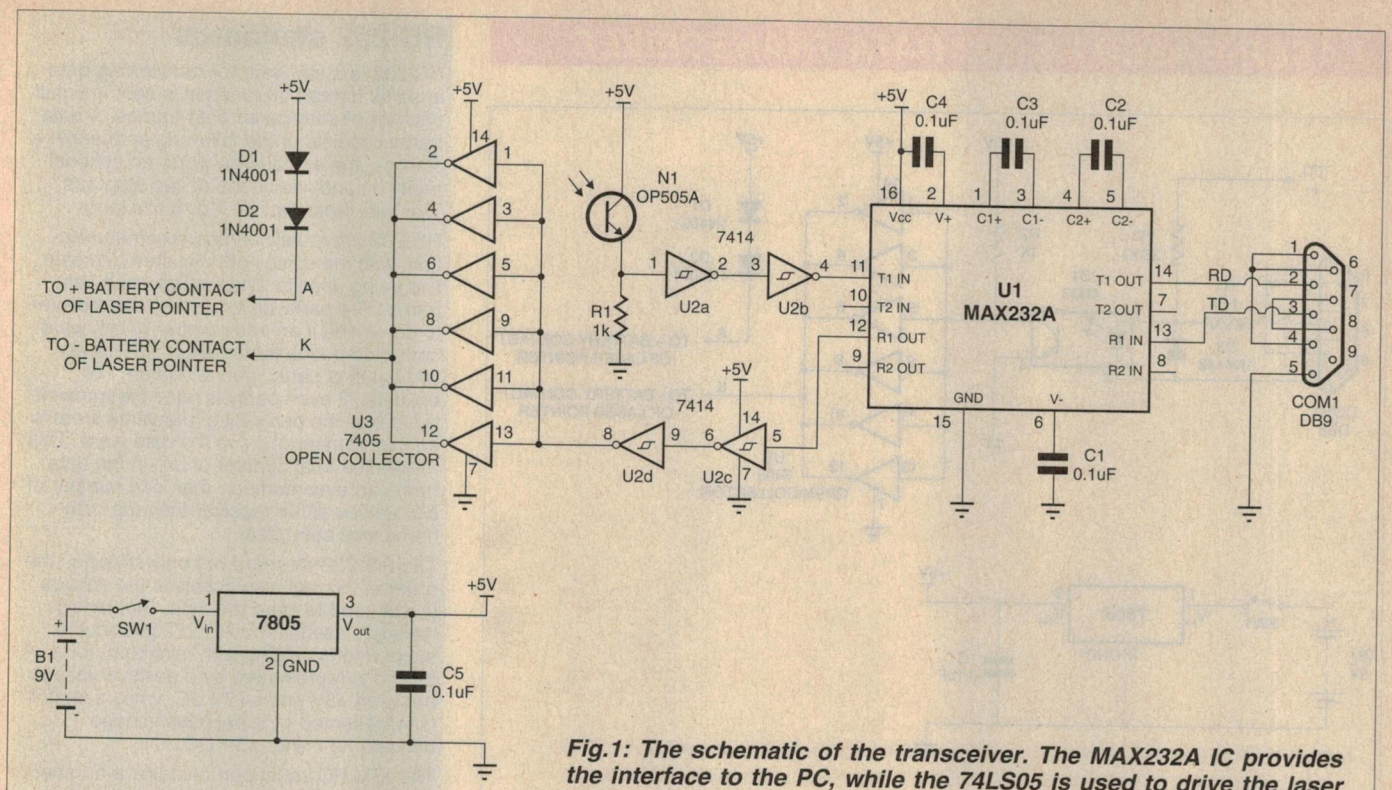


Fig.1: The schematic of the transceiver. The MAX232A IC provides the interface to the PC, while the 74LS05 is used to drive the laser diode inside the laser pointer.

charge-pump voltage converter from a single +5V DC rail (see box for more information on RS-232 standards). Note that several different versions of the MAX232 chip exist. The A version requires only 0.1uF capacitors for the charge-pump and inverter, whereas the MAX232 requires 1uF capacitors. The advantage of the A version is that it has faster response times, and allows for faster data rates.

On the transmitting side, the laser diode driver consists of a 7405 open-collector hex inverter IC (U3). All the outputs of the inverters are coupled together to provide enough drive current for the laser diode, which draws around 35mA at 3V. The parallel inverters are driven with the transmit data from U1 via buffers U2c and U2d.

A 7805 voltage regulator is used to provide the ICs and laser diode with a stable 5V voltage source. The two 1N4001 diodes in series with the laser diode (D1, D2) step down the voltage from +5V DC to around 3.6V, which is close to the nominal voltage for the laser diode.

The transceiver is designed in such a way that when no signal is present the laser is on. This helps you see where the laser is pointing during the laser-detector alignment. The complete transceiver is powered by a 9V battery and draws approximately 80mA (laser on) and 40mA (laser off).

The transmitter

The transmitter module differs from the transceiver in the fact that it can only transmit data. It's somewhat simpler (Fig.2), consisting of an opto-isolator, an open-collector hex inverter and a handful of other components. The transmitter is also powered by a 9V battery and draws approximately 70mA (laser on) and 30mA (laser off).

The circuit uses an opto-isolator (4N33) to couple a standard RS-232 signal from a computer to the driver section of the circuit. The resistor/diode configuration at the input to the opto-isolator converts the +12/-12V voltage swings of a RS-232 signal into a signal suitable for the LED in the opto-isolator.

A second input on the board is also provided for external TTL compatible signals. This can be wired to the parallel

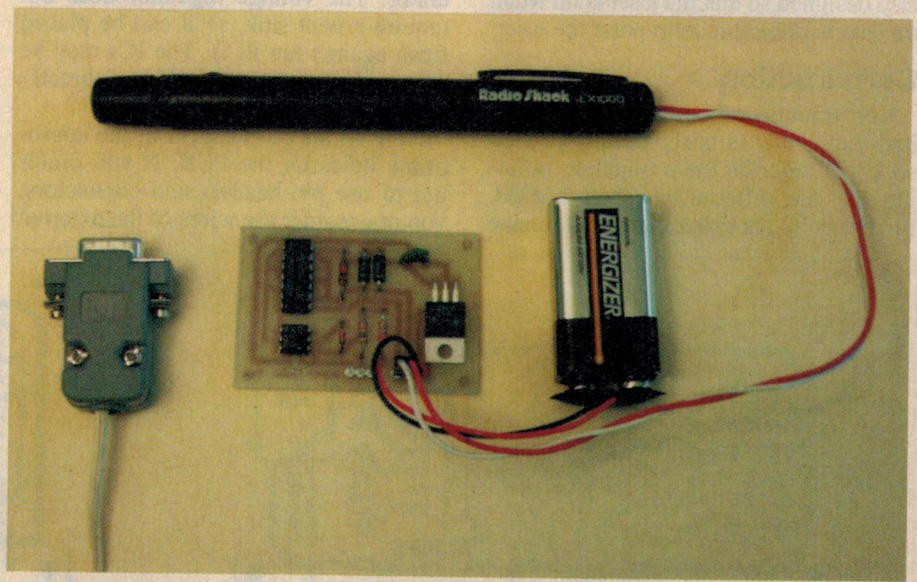


Fig.6: Here is the assembled transmitter, in this case pictured with the 'dummy battery' inserted into the laser pointer. The transmitter accepts both RS-232 and TTL compatible signals as inputs.

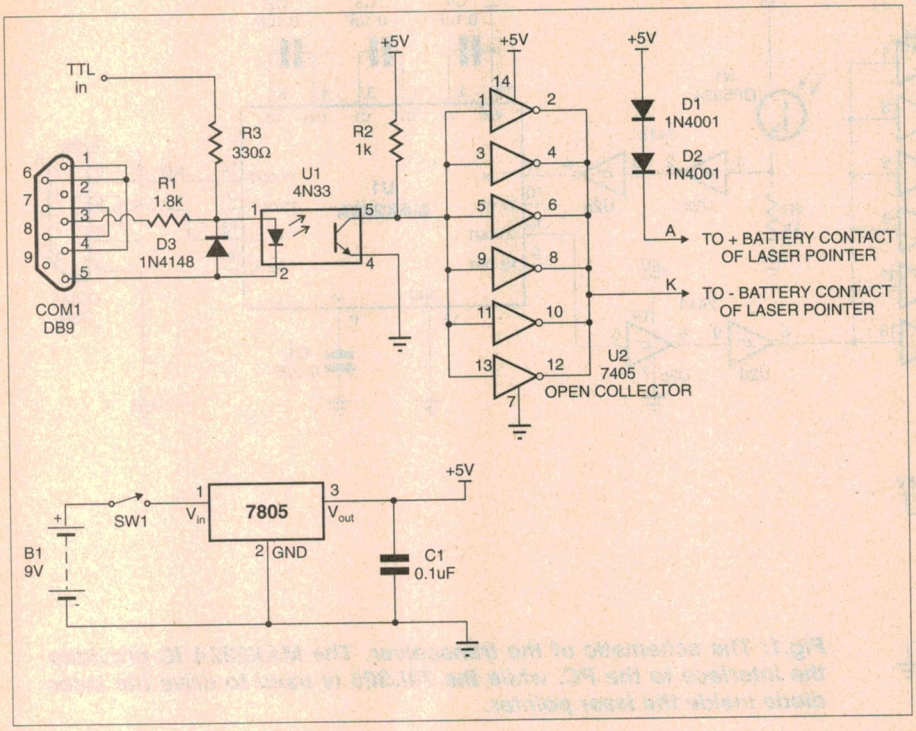


Fig.2: The circuit diagram of the transmitter. The laser diode driver is identical to the driver in the transceiver. The bipolar RS-232 signal is converted to a TTL compatible signal via D3, R1 and the opto-coupler.

RS-232 standards

RS-232 is a standard for transferring data in serial format. Information is sent in small packets of data called data frames. A data frame consists of the following sequence: a start bit, the actual data word, an optional parity bit and finally one or two stop bits. The data word can be 7 or 8 bits long.

RS-232 offers *asynchronous* communication, with the combination of start and stop bits being used to synchronize each data frame. The parity bit is used by the receiver to determine if an odd number of bits were corrupted during transmission. There are two types of parity, odd and even. For example, if even parity is used the transmitter makes the parity bit a 1 anytime there is an odd number of 1's in the data word. This makes the total number of bits in the data frame an even number. If an odd number of bits arrives at the receiver then the data frame was corrupted.

The RS-232 standard not only specifies the order of bits but also specifies the voltage levels used to send the data. Bipolar signalling is used in the RS-232 protocol to support long cabling with minimum noise. A logic 0 is represented by a positive voltage between +3V and +15V DC, while a logic 1 is represented by a negative voltage between -3V and -15V DC.

The IBM PC serial port contains a number of *handshaking* lines, which are used to indicate the willingness of the receiver to receive data and of the transmitter to send it. These are not strictly needed and so I will not cover them here.

port of the computer or other microcontrollers. **Note: Never use the TTL input signal at the same time as the RS-232 input signal as these are shorted together only via a resistor**.

The laser diode driver section is identical to the one used in the transceiver. The driver section of the transmitter is also designed so that the laser is on when no data is present to help point the laser.

Construction

Construction of both the transmitter and transceiver is fairly straightforward so I will describe them together, pointing out the differences when needed. First start by checking the PCB to make sure it is clean and free from dirt. Next mount all the passive components (resistors and capacitors), using one or other of the overlay diagrams of Fig.3 as a guide. You can also mount the diodes, taking note of their polarity.

Next fit the active components. This includes all the ICs and the voltage regulator. The voltage regulator does not require a heat sink, so it can be placed flush against the PCB. The ICs may be mounted in sockets or soldered directly to the PCB.

Now fit the pin-headers to the appropriate holes on the PCB. If you prefer not to use pin-headers and connectors, you may solder the wires of the external components directly to the PCB.

Now you are ready to start attaching the external components, using Fig.9 or Fig.10 as a guide. These components include the laser pointer, photo-transistor, battery connector, switch and the DB-9 connector. I will leave it up to you as to how you want to house the project, but I suggest that you use a zippy box so that you can mount the photo-transistor and switch.

To mount the photo-transistor, you can simply drill a snug hole in the side of the zippy box and use that to secure the photo-transistor. Alternatively a block of plastic or wood, with a hole drilled in it for the photo-transistor, can be attached

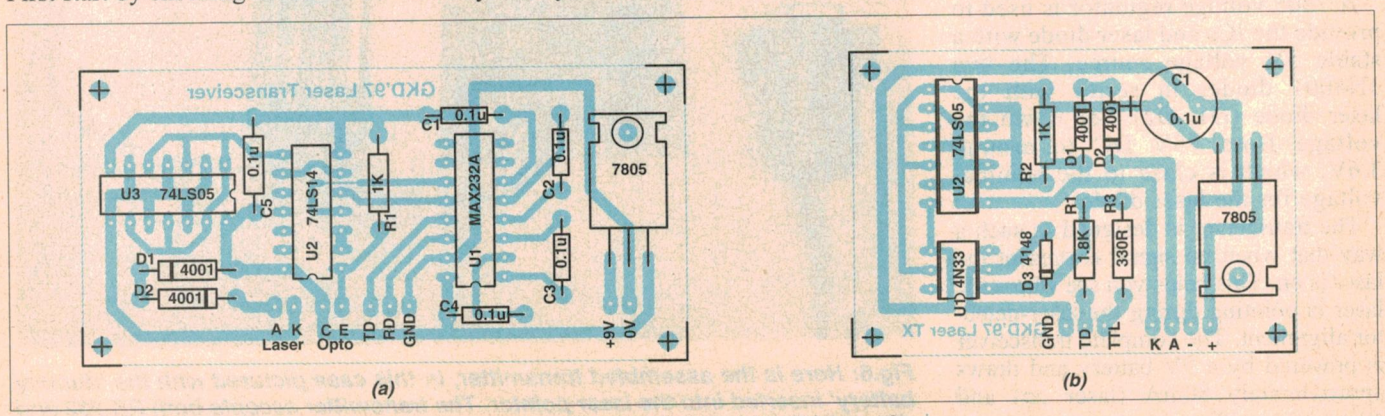


Fig.4: Overlay diagrams for both the transceiver (a) and transmitter (b) boards.

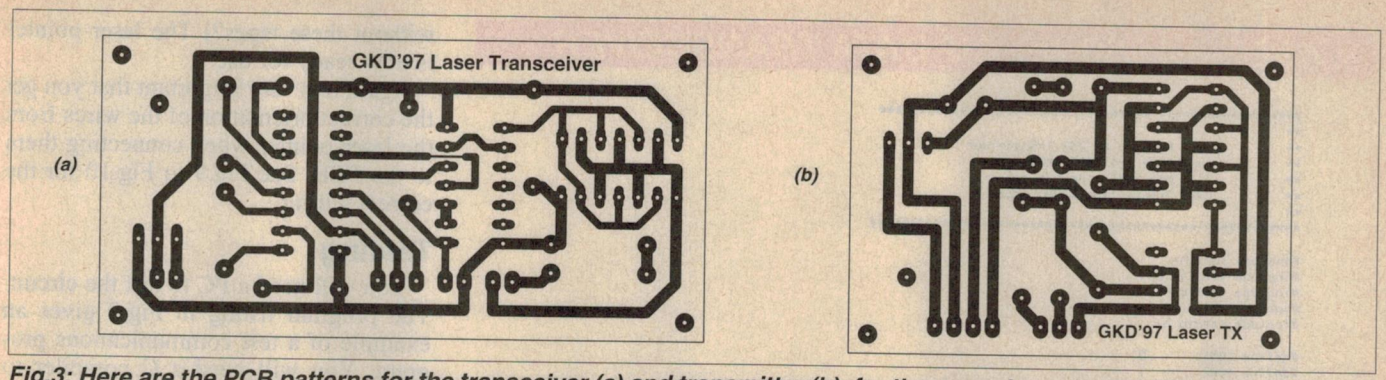


Fig.3: Here are the PCB patterns for the transceiver (a) and transmitter (b), for those readers who want to make their own. The layouts are copyright to GKDesign.

to the top of the zippy box. The advantage of the block is that it can also shield the photo-transistor from ambient light. Take particular care with the orientation of the photo-transistor when clipping the pins and soldering wires to it.

Now you need to prepare the serial connector. You may use a standard (female) DB-9 or DB-25 connector, depending on your needs. I will describe the connections for the DB-9 connector as this is found on most IBM-PCs. (See Fig.8 for the connections to both a DB-9 and DB-25 connector)

The IBM PC serial port contains several data and handshake lines. We will only be using the Transmit Data (TD), Receive Data (RD) and common ground (GND) lines. Handshaking will be done in software. In order to make the serial port happy we need to connect the Data Terminal Ready (DTR) line to the Data Set Ready (DSR) and Data Carrier Detect (DCD) lines. We also need to connect the Request To Send (RTS) line to the Clear To Send (CTS) line. This has the effect of tricking the serial port into thinking that it is always ready to receive and send data.

These links should be soldered inside the connector itself. Only three wires are required for the connection to the transceiver. Connect the three wires to the RD (pin 2), TD (pin 3) and GND (pin 5) lines of the connector. For the transmitter, wire only the TD (pin 3) and GND (pin 5) lines. A length of four-core flexible telephone cable works great. (Make sure no one is using the phone at the time!) Again ensure that the wires are correctly wired to the PCB.

Next connect the black wire of the 9V battery clip to the PCB and the red wire to one contact on the switch. The other switch contact should then be wired to the PCB. You can use light duty hookup wire to achieve this.

The last, and most interesting, component needs to be wired to the circuit — the laser. We must first prepare the laser pointer since almost none have wires already hanging from them.

The preparation will vary on the laser pointer you have, but most should have easy access to the battery compartment. The most suitable laser pointers are the ones that require two AAA- or AA-size batteries. The laser pointer I used in these circuits is the LX1000, purchased at Radio Shack.

First remove the batteries, carefully noting the polarity of the contacts. You now need to connect a wire to each battery contact. Depending on the laser pointer case, you may need to create a 'dummy battery' in order to reach the contacts. For the laser pointer used in this design, in order to reach the negative contact located deep inside the case, a metal rod was cut to the length of both batteries and a wire was soldered to the end of it. The rod can be made from a bolt or large diameter nail with the head cut off. The rod was wrapped in electrical tape to insulate it from the pointer's aluminium case, which formed the other contact. An exposed wire was then taped to the insulation of the rod so that it made reliable contact with the case when the rod was inserted. This made the positive contact.

One more step and we are ready to use the laser. Usually most laser pointers have a push-on switch to turn on the laser. This switch can simply be taped down with electrical or 'gaffer' tape to hold it closed. (Where would we be

Fig.9 (right): Use this diagram to connect up the finished transceiver board to the laser pointer and other off-board components.

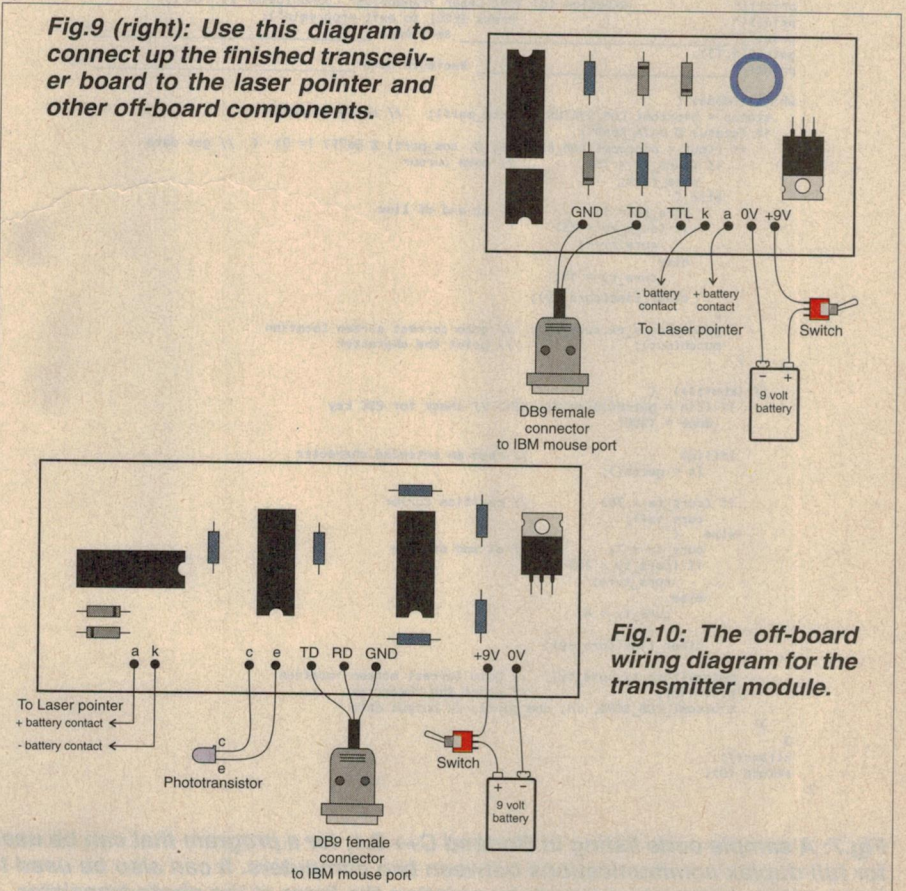


Fig.10: The off-board wiring diagram for the transmitter module.

```
/*****************************************************
**
**        Laser Pointer RS-232 Transceiver
**         Copyright (c) 1997 GKDesign
**         24th May 1997   George Katz
**         Data Transmitted @ 9600 bps
**
*****************************************************/

#include <dos.h>
#include <stdlib.h>
#include <conio.h>
#include <bios.h>
#include <stdio.h>

#define COM1        0
#define COM2        1
#define DATA_READY 0x100
#define TRUE        1
#define FALSE       0
#define ESC_KEY     '\x1b'

#define SETTINGS ( _COM_9600 | _COM_CHR8 | _COM_NOPARITY | _COM_STOP1)

void clear_line(int line)
{
    int i;

    gotoxy(1,line);     // clear a whole line
    for(i=0;i<80;i++)
        printf(" ");
}

int main(int argc, char *argv[])
{
   int in, out, status, done = FALSE;
   int curs_rx=0,curs_ry=15,curs_tx=0,curs_ty=4;
   int com_port=COM1;

   if (!(argc == 2 && (argv[1][0] == '2' || argv[1][0] == '1')))
   {
      printf("Usage: LASER [1|2]\nwhere 1 = Com port 1\n      2 = Com port 2\n");
      exit(-1);
   }

   if (argv[1][0]=='2') // select com port
      com_port = COM2;
   else
      com_port = COM1;

   bioscom(_COM_INIT, SETTINGS, com_port);    // Initialize serial port

   clrscr();
   printf("            GKDesign (c) 1997 Laser Transceiver Communicator V1.1\n");
   printf("                              Press [ESC] to exit program\n");
   printf("_____________________________ Sent Data _____________________________");
   gotoxy(1,13);
   printf("_____________________________ Recieved Data _____________________________");

   while (!done) {
      status = bioscom(_COM_STATUS, 0, com_port);   // recieved data?
      if (status & DATA_READY)
         if ((out = bioscom(_COM_RECEIVE, 0, com_port) & 0x7F) != 0)  {  // get data
            if (curs_rx < 78)          // move cursor
               curs_rx++;
            else {
                curs_rx = 1;           // at end of line
                if (curs_ry < 23)
                    curs_ry++;
                else
                    curs_ry = 15;
                clear_line(curs_ry);
            }
            gotoxy(curs_rx,curs_ry);  // goto correct screen location
            putch(out);               // print the character
         }

       if (kbhit())  {
           if ((in = getch()) == ESC_KEY) // check for ESC key
              done = TRUE;

           if(!in)                    // read an extended character
               in = getch();

           if (curs_tx < 78)          // position cursor
               curs_tx++;
           else   {
               curs_tx = 1;           // at end of line
               if (curs_ty < 12)
                   curs_ty++;
               else
                   curs_ty = 4;

               clear_line(curs_ty);
           }
           gotoxy(curs_tx,curs_ty);  // goto correct screen location
           putch(in);                // print the character
           bioscom(_COM_SEND, in, com_port); // output data
       }
   }
   clrscr();
   return (0);
}
```

Fig.7: A sample code listing in Borland C++ 3.1, for a program that can be used for full-duplex communications between two computers. It can also be used to test a single transceiver simply by pointing the laser at the photo-transistor.

without these tapes?) The laser pointer is now ready for use.

Again it is very important that you get the correct orientation of the wires from the laser pointer when connecting them to the PCB. See Fig.9 or Fig.10 for the correct wiring.

Testing

You will need a PC to test the circuit. The program listing in Fig.7 gives an example of a test communications program. You will need a C compiler to compile it. The code was compiled using Borland C++ 3.1. If you do not have a compiler or wish to obtain the executable version of the test program, you can find it on my web page (**http://www.geocities.com/SiliconValley/Lakes/7156**).

To test the circuit, plug the DB-9 connector into the mouse port on your PC. Turn on power to the circuit and the laser should switch on. Now turn on the PC and make sure a mouse driver is not loaded. A TSR (Terminate and Stay Resident) mouse driver will interfere with the operation of the circuit. Also make sure that no other TSRs are attempting to use the serial port.

Now point the pointer directly at the photo-transistor. Next run the test program from a DOS prompt by typing LASER 1 and pressing the <RETURN> key. Here the '1' represents the COM port number the circuit is connected to, so change it to '2' if you're connected to COM2.

Anything you type on the keyboard should appear at the top of the screen as well as the bottom. The top part of your screen displays the data sent out over the laser pointer, while the bottom part shows the received data. Press the ESC key at any time to end the program.

To test communication between two computers, simply repeat the steps above for each computer except that each transceiver's laser is pointed towards the other transceiver.

Over longer distances I have found that it is much easier to fix the laser and move the receiver in order to align them properly. For this reason the laser should not be attached to the zippy box housing the photo-transistor.

Also depending on the laser pointer, beam intensity and beam spread will vary — which will affect the distance over which reliable communication can be achieved. Most laser pointers should achieve a minimum of 100 metres. And if all goes well you will soon be sending data over a laser beam!

Using the sample code it is now up to you to write the program to suit your needs.

PARTS LIST
Transceiver:

Resistors

R1	1k 1/4W 5%

Capacitors

C1-5	0.1uF (ceramic)

Semiconductors:

U1	MAX232A RS-232 line driver
U2	74LS05 Hex open-collector buffer
U3	74LS14 Hex Schmitt inverter
D1-2	1N4001 Power diode
N1	OP505A Photo-transistor
V1	7805 5V voltage regulator
L1	LX1000 laser pointer

Miscellaneous

PCB, 80 x 39mm; 9V battery clip; DB-9 female connector with backshell; 2m length shielded three-core cable; SPST switch; light duty hook-up wire.

Transmitter:

Resistors

R1	1.8k 1/4W 1% metal film
R2	1k 1/4W 5%
R3	330 ohms 1/4W 5%

Capacitors

C1	0.1uF (ceramic)

Semiconductors

U1	4N33 opto-coupler
U2	74LS05 hex open-collector buffer
D1-2	1N4001 power diode
V1	7805 5V regulator
L1	LX1000 laser pointer

Miscellaneous

PCB, 58 x 40mm; code; 9V battery clip; DB-9 female connector with backshell; 2m length shielded two-core cable; light duty hookup wire; SPST switch.

What next?

The laser experiments do not have to end there. You can use the transmitter section of this design to create laser light shows. By attaching mirrors to servo motors and pointing the modulated laser beam at them, you can create patterns and images. ❖

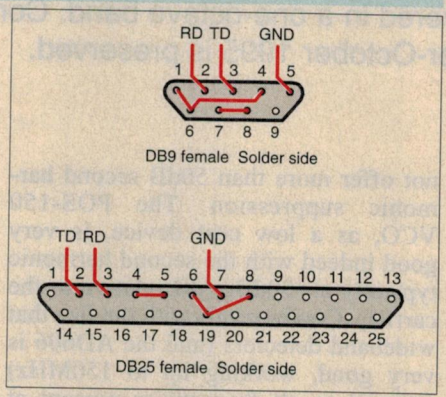


Fig.8: This solder side view shows how to wire the DB-9 (female) or DB-25 (female) connector for an IBM PC compatible computer.

Construction Project:

IMPROVED HETERODYNE DDS/PLL SWEEPER

In this follow-up article to those of January-May 1997 describing his YADDS VHF/UHF Sweeper, the author describes how to build a DDS/PLL Sweeper with a heterodyne RF detector. In addition to offering superb dynamic range (80dB) in the whole frequency range for sweeper applications, this new arrangement can also be used as a simple spectrum analyser, with calibrated frequency and amplitude axes. The setup is not limited to VHF — using the UHF PLL modules, frequencies up to 1GHz can be covered in a one-octave band. Compatibility with the original baseband DDS sweeper of September-October 1995 is preserved.

by TIBOR BECE

In the previous articles describing the PLL extension to the YADDS Sweeper, the AD606 logarithmic detector was suggested as the best, 'no compromise' solution. However, this is true only if lowpass or bandpass type circuits are measured. Measuring other types of circuits, it is quite easy to 'bump' into system limits. For example, Fig.1(a) is the response obtained from a seventh-order Chebishev LC highpass filter, using the AD606 detector. As you can see, the trace is quite erratic below 90MHz and -30dB referred to full scale.

This behaviour is in fact quite normal for all sweep analysers with wideband detectors. Namely, even the best commercial high frequency generators do not offer more than 50dB second harmonic suppression. The POS-150 VCO, as a low cost device, is very good indeed with the second harmonic typically at -30dBc (dB relative to the carrier). Combine this with the fact that wideband detectors (and the AD606 is very good, working up to 150MHz) respond to all frequencies present at their input, fundamental or harmonics.

If the device under test is a highpass filter, as in this case, when the fundamental gets attenuated (below fc) the harmonics can still get through — producing the erratic reading. A wideband detector is of course unable to differentiate between the wanted frequency and a harmonic or spurious content.

Note that the original RF Sweeper (*EA* Sep/Oct 1995) also suffers from this limitation, but to a much lesser extent due to the better spectral purity of the DDS generator and the inherent high frequency rolloff in the MC3356 logarithmic detector.

A different approach to a sweep analyser is making the detector stage frequency selective. Of course the circuitry is more complex, but the measurements made with such an instrument are more accurate. The frequency selective sweep analyser usually comes in the form of a spectrum analyser with a built-in tracking generator.

With the addition of a 'tracking receiver' to the YADDS VHF/UHF Sweeper, the performance of the VHF unit can be significantly improved — for around the same cost as adding a high quality AD606 log detector. For example, the swept response of the same highpass circuit as before, this time captured using the new heterodyne sweeper system, is shown in Fig.1(b). As you can see, the stopband slope is now clean and uniform.

The second trace in Fig.1(b) is the expanded view of the passband, at 1dB/division. The insertion loss of the circuit and the passband ripple, inherent in the Chebishev filters, is easily visible.

Everything still fits in the original instrument case, although there's a lot more inside than in the original HF Sweeper.

Circuit details

As you would expect, a second YAPLL module is required for the local oscillator. The driver software keeps the two PLLs offset by a fixed frequency, as required for a heterodyne setup.

At first, it may seem that a second YADDS reference is required too, but (luckily) even if both PLL modules are

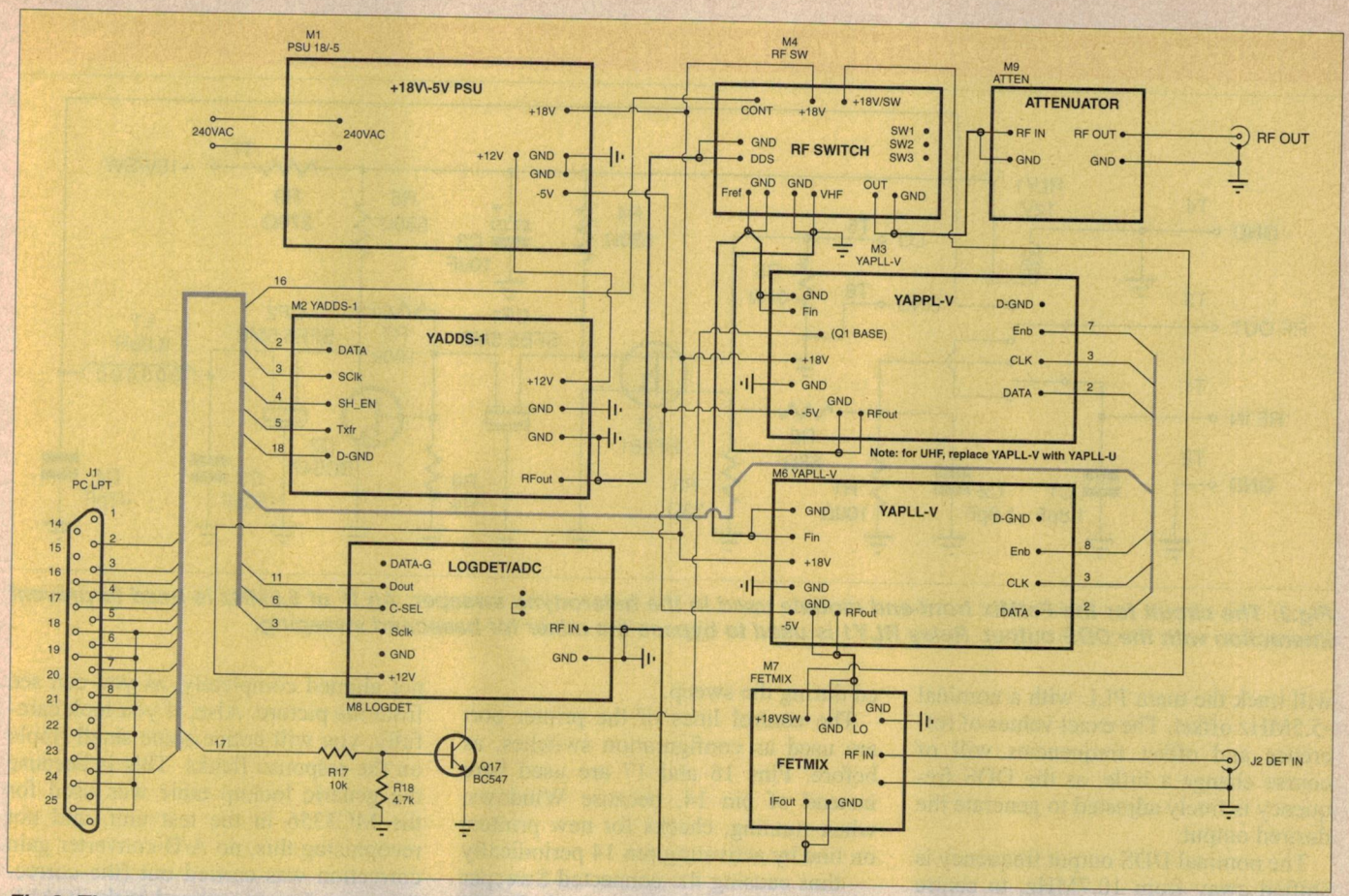


Fig.2: The block diagram for the new heterodyne sweeper. The only new sections are the second 'local oscillator' YAPLL-V module (M6) and the FetMix mixing front end/IF filter.

driven from the same DDS source, the tracking error is so small (+/-5kHz or less) that it can be neglected. Using only one DDS generator the general layout of the original VHF Sweeper can be preserved, thus one YADDS-1 was used in the prototype.

The block diagram of the new Heterodyne VHF Sweeper is shown in Fig.2. In addition to the second YAPLL module, the only new component is 'FetMix', a small front end mixer/IF amplifier PCB. The circuit diagram of this new front end is shown in Fig.3, while the PCB pattern and component placement are shown in Fig.4. Note that, as before, the top layer of the PCB is solid copper, removed only around the component leads.

As you can see, the circuit is very simple. A BF961 dual-gate MOSFET is used as a mixer. Two small 5.5MHz ceramic filters provide the IF selectivity, while the 680Ω resistors R4 and R8 provide the required termination.

An IF frequency of 5.5MHz is used here to avoid picking up the 10.7MHz DDS output which is used to control the YAPLL modules. Also, it is easier to achieve the required gain with the 680Ω load required by the SFE5.5MB ceramic filters.

The two 1.8pF capacitors on the input constitute an LC lowpass filter with the inductance of the relay contacts, thus equalising the frequency response above 300MHz. This becomes important if two UHF PLLs are used to cover, for instance, the 400MHz to 800MHz range, or higher.

An L-match circuit on the output provides impedance matching without power loss between the 600Ω impedance of the ceramic filter and the 50Ω input of the LogDet board. Relay RLY1 is used to bypass the complete front end if the supply voltage is not connected, so the Sweeper can still be used in the 100kHz to 22MHz baseband range, for compatibility.

The gain balance of the mixer stage is carefully set to maximise the available dynamic range. With the values shown, the 1dB compression point referenced to the input is 9dBm at 100MHz. As a result, the full output of the YAPLL can be applied to the detector without clipping.

Regardless of this, it is always good practice to add at least 10dB of attenuation to the output of the generator in order to stabilise the output impedance to 50Ω. With the extra gain and dynamic range available, 10dB or 20dB loss is no concern any more.

The overall loss of the front end is around 8dB, thus an 8dBm input signal at 100MHz appears on the IF output port as a 5.5MHz, 0dBm IF signal. This just starts to overload the MC3356. The system noise floor is around -80dBm, giving a total of 90dB available for measurements. With the suggested layout, there is no crosstalk between the generator and detector at VHF frequencies.

Software setup

To drive the new heterodyne unit, version 3.22 or later of the Sweeper software is required. To set up the detector calibration frequency and operating conditions for the PLL modules, the following commands have to be added to the setup file (the file 'VHFMIX.SET' already contains these):

f_if=5500.0
aux_PLL_track=1
PLL_R=107
aux_PLL_R=107
PLL_xtal=10.640
track_offset_N=-55

This sets up the PLL reference on both modules to a nominal 100kHz. With the values shown, the receiver LO

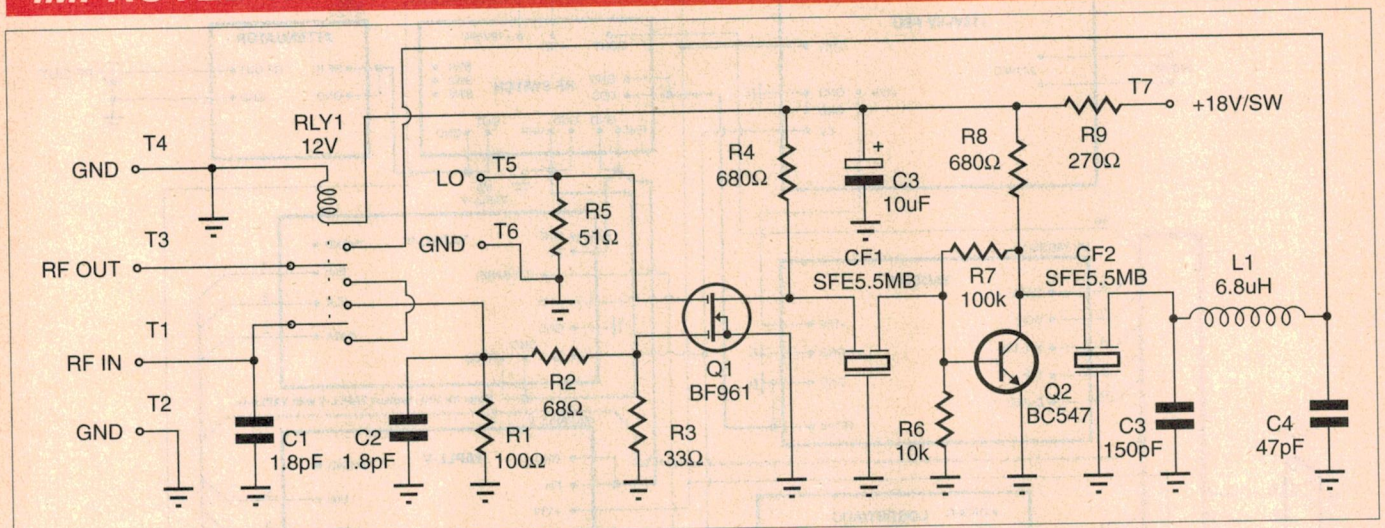


Fig.3: The circuit for the FetMix front-end module used in the heterodyne sweeper. An IF of 5.5MHz is used to prevent interaction with the DDS output. Relay RLY1 is used to bypass the mixer for baseband sweeping.

will track the main PLL with a nominal -5.5MHz offset. The exact values of reference and offset frequencies will of course change a little, as the DDS frequency is finely adjusted to generate the desired output.

The nominal DDS output frequency is shifted away from 10.7MHz, to centre the actual IF to the flat portion of the 5.5MHz IF bandpass response. Namely, with the component values shown, the flattest part of the bandpass is around 5.47MHz. Setting the nominal IF to this value minimises the amplitude modulation caused by the tracking error of the two PLL modules (caused by a single DDS source). The actual IF frequency will oscillate around the nominal value of fif=PLL_xtal/PLL_R*track_offset by a few kHz, as the DDS output is adjusted during the sweep.

The control lines of the printer port are used as configuration switches, as before. Pins 16 and 17 are used here instead of pin 14, because Windows, when running, checks for new printers on line by activating pin 14 periodically — thus causing the connected Sweeper relays to click every few seconds. Pin 16 is used to drive the VHF relay switch, while pin 17 is used to disable the generator PLL if the unit is used as a spectrum analyser (see later).

Application examples

As an example of the available precision and dynamic range of the new Heterodyne Sweeper, Fig.5 shows the swept responses of a 2m amateur repeater cavity diplexer. The diplexer is not aligned completely, as you can see from the picture. Also, if you look carefully, you will notice some small ripple on the response flanks. This is because the generic lookup table was used for the MC3356 in the test unit, and not recognising this, no A/D converter gain correction was carried out (the correction procedure is outlined in the 'CALIBRAT.DOC' file on the distribution floppy). This ripple is typical for an uncalibrated sweeper system.

To cover UHF frequencies, two YAPLL-U instead of the YAPLL-V modules can be used, without any further changes. The available dynamic range will depend on the layout and shielding, but at least 60 to 70dB can be expected. Fig.6 shows the swept response of the same helical filter as

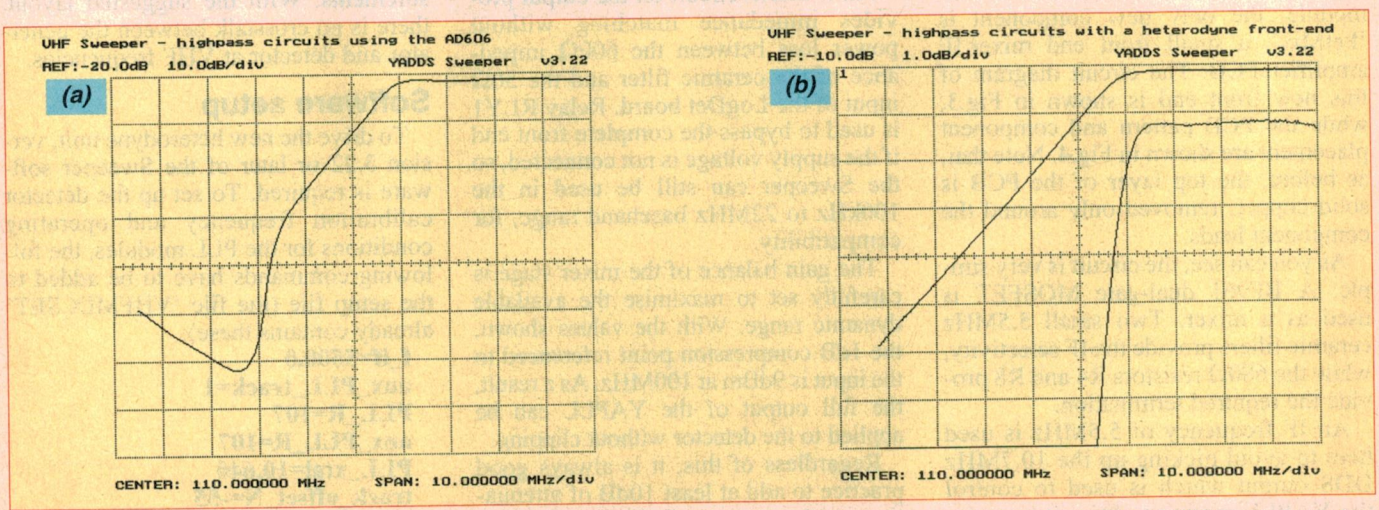


Fig.1: At left (a) is the response of a seventh-order highpass filter, measured using the AD606 wideband detector. For comparison, (b) at right shows the same filter swept using the new heterodyne detector, at both 10dB/div and 1dB/div (lower curve).

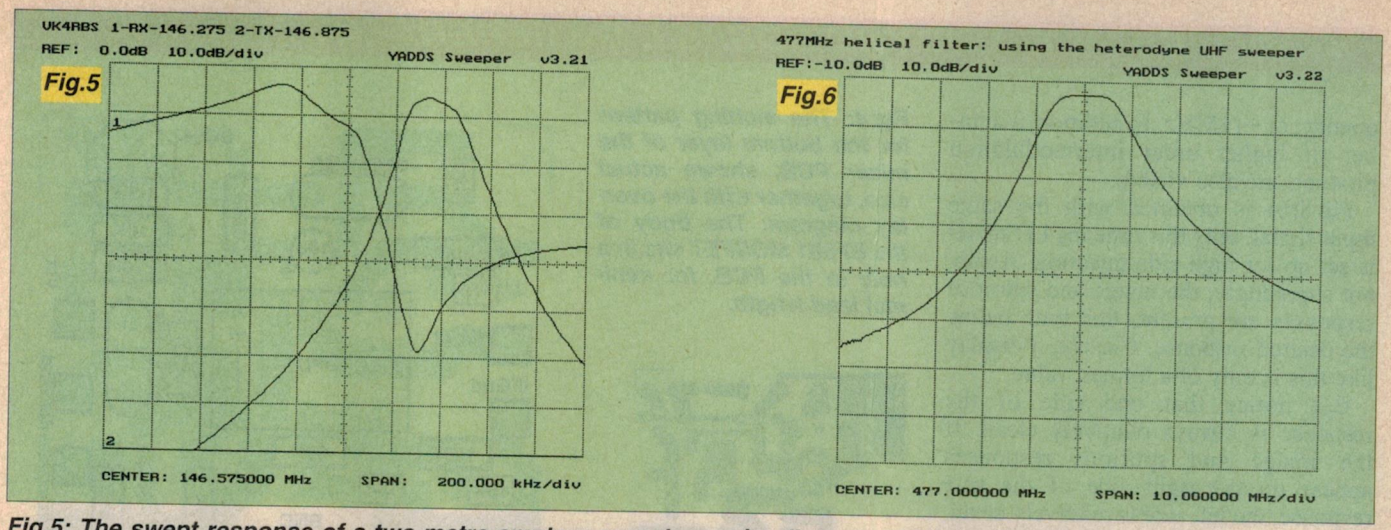


Fig.5: The swept response of a two-metre amateur repeater cavity diplexer which is not aligned completely. Fig.6: The response of the 477MHz helical filter shown in Fig.25 of the May 1997 article, swept using the new heterodyne sweeper.

shown in Fig.25 of the May 1997 article (which was captured using the wideband diode detector, not the MAR-3 wideband detector as stated).

Construction

Assembling the mixer front end PCB is straightforward. The only point to note is the mounting of the MOSFET. As usual for this case type, it is mounted in a 5mm hole drilled in the PCB. Before trimming the leads to the required lengths, identify the pins — the drain is the longest lead, while the source has a small mark near the case body. The FET is soldered in so that the labelling is visible from the bottom side of the PCB.

After assembly, the mixer board should be soldered to the front panel ground plane as close to the input BNC socket as possible. A piece of thicker wire, soldered in at 45°, provides additional mechanical rigidity. The tip of the BNC can either be soldered directly to the PCB, or using a short piece of wire, as in the prototype unit.

A coaxial cable connects the front end to the LogDet board. The short wire link, connecting the LogDet input ground to the chassis is very important — it reduces signal leakage from the YADDS module in the baseband sweeper mode. Also, it prevents damage to the printer port if the interconnect coaxial cable is accidentally disconnected, as the board, left without a ground connection, would supply the full +18Vcc back to the printer port (note that the only point where the LogDet is connected to ground is near the input terminals).

It is a good idea by the way to drive all printer port-driven instruments from a second LPT card, because if anything goes wrong (late on a Saturday night for example), the damage will at least be localised...

The LO YAPLL module can now be mounted above the mixer PCB, using three short wire links soldered to the chassis and the mounting holes. Additional ground wires can be added to provide mechanical strength and improve grounding, but make sure everything is working properly before doing too much soldering — it may be difficult to reverse the process.

The short coaxial cable connecting the YAPLL to the mixer is soldered to the bottom side of the YAPLL, so that the module can be mounted flush against the dividing wall. To simplify soldering to the coaxial cable, a Teflon insulated cable can be used (DSE catalog item). This cable is heat resistant, thus it will take much more abuse from the soldering iron than a normal RG-174.

Fig.7 is a close-in photograph of the unit, showing the assembly details of the new heterodyne front end. As you can see, everything still fits nicely in the original RF Sweeper case.

Spectrum analysis

With a frequency selective detector stage available, it becomes tempting to use the Sweeper as a Spectrum Analyser. Fig.8(a) shows the screen obtained from a 100MHz, -20dBm signal connected to the detector input. As you can see, in addition to the desired response at 100MHz, the image response appears at twice the IF fre-

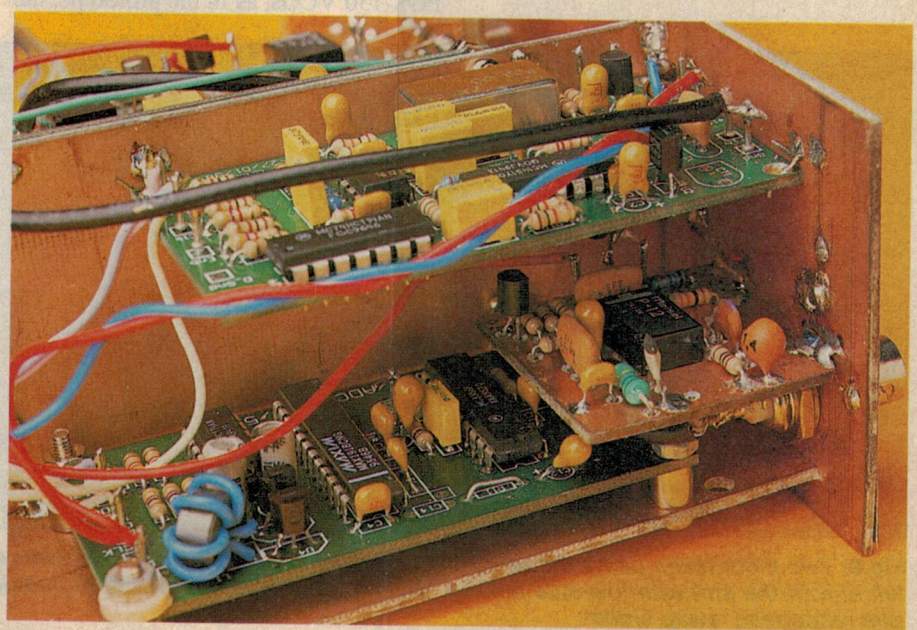


Fig.7: A closeup photo of the new sweeper, showing the new mixer module mounted immediately behind the RF input connector, with the second 'local oscillator' YAPPL-V module above it.

quency, or +11MHz. In addition, a number of higher order intermodulation products are also visible.

Fig.8(b) is obtained with the same input signal, only this time the LO offset is set up for high side injection. Again, not suprisingly, the image and spurious responses are present, this time below the desired response. Clearly, a display like this is only of a limited value.

But notice that one side of the response is always relatively clean. If the image and spurious responses appear on the right side of the true response, the left side is relatively clean, and vice versa. This suggests that perhaps a *software* technique could be successful for spurious suppression. The idea is to do two sweeps for every display, once with low and once with high side LO injection, and combine the two responses, selecting the minimum response for each frequency point.

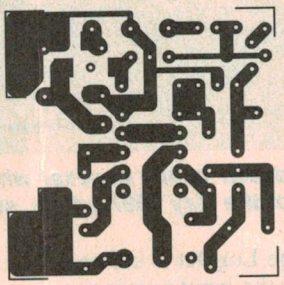
Sweeper v3.22 (and later) has this feature available. To activate it, the line

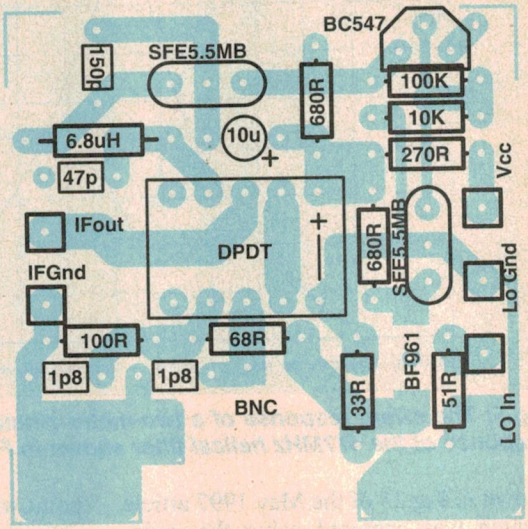
track_offset_alternate=1

should be placed in the setup file.

With this option activated, the 100MHz generator signal looks suprisingly clean, almost like a dedicated spectrum analyser as you can see from Fig.9. Fig.10 is the display of two closely spaced signals, a test for the high level signal handling of a spectrum analyser. Clearly, at least 65dB two-tone IM free dynamic range is available, which compares favourably with any low cost spectrum monitor/spectrum analyser project, or any ready-made unit available below the $1000 mark.

Fig.4: The etching pattern for the bottom layer of the mixer PCB, shown actual size, together with the overlay diagram. The body of the BF961 MOSFET sits in a hole in the PCB, for minimal lead length.





Limitations...

Using this simple software technique to correct for spurious response, a quite useful spectrum analyser display can be obtained. The frequency and amplitude points are accurately calibrated, thus the instrument can be used for serious measurement purposes. The amplitude range is from -80dBm to 9dBm. The resolution bandwidth is fixed to around 170kHz, which is similar to the majority of low cost spectrum monitors. This resolution bandwidth is well suited for spans of 500kHz/div up to 10MHz/div.

There are some limitations to this technique, though. Firstly, the frequency range is limited to the one-octave coverage of the PLL module. Using the POS-150 VCOs, as in the prototype, the frequency range covered is 65MHz to 158MHz. Using two YAPLL-U modules fitted with POS-765s, a range from 430MHz to 800MHz was obtained.

Neither of these ranges extends down to low frequencies, but they cover frequencies above what would normally be possible if the same PLL was used in a standard, 'high first IF' arrangement.

A surprising aspect of instrument behaviour is that signals of varying frequencies tend to disappear from the screen altogether. This is because as the minimum response is selected for each frequency point, a signal that appears at different locations for the two consecutive sweeps is classified as a 'spurious', and is completely rejected.

To track moving signals, the software spurious suppression is best turned off,

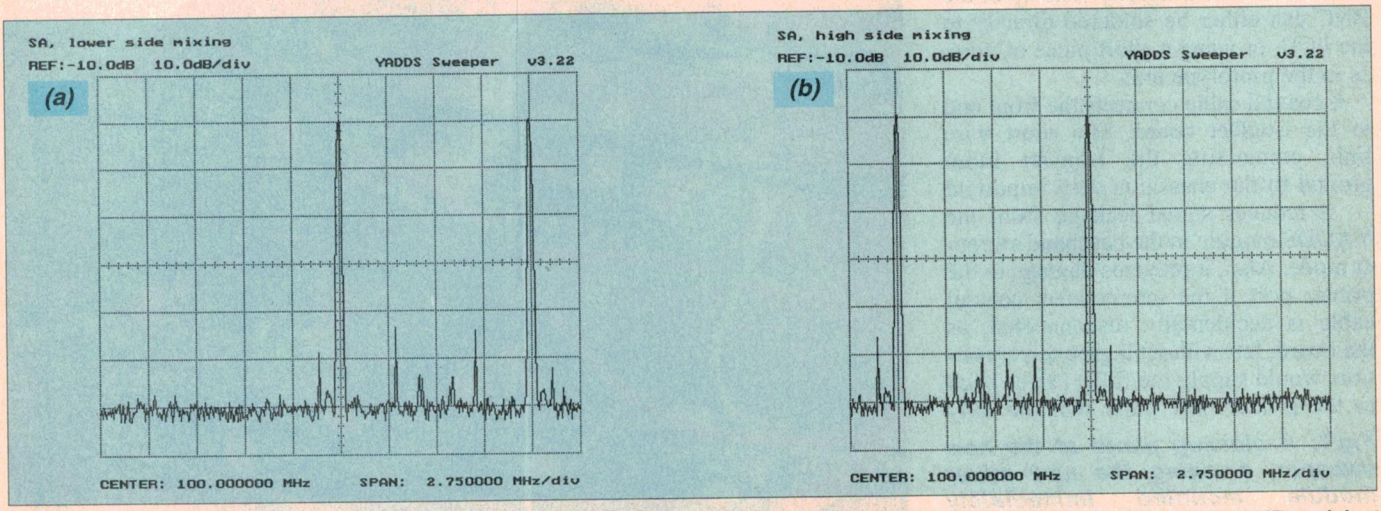


Fig.8: Two plots taken using the new heterodyne sweeper as a spectrum analyser, for a 100MHz signal of -20dBm. (a) at left shows the plot with low-side mixing, while (b) shows the plot with high-side mixing. Note how the image and spurious responses 'swap sides'.

Fig.9: When the author's software spurious suppression feature is active, the images and spurious outputs largely disappear.

Fig.10: The sweeper used as a spectrum analyser, displaying two closely-spaced signals at 100MHz and 105MHz. The two-tone IM free dynamic range is at least 65dB.

Fig.11: One limitation of the software technique for spurious suppression is that it can be 'fooled' by two signals 22MHz apart. Signals of varying frequency also tend to 'disappear'.

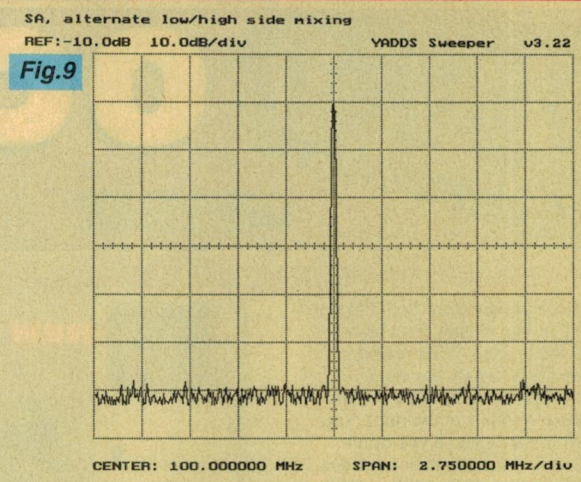


Fig.9

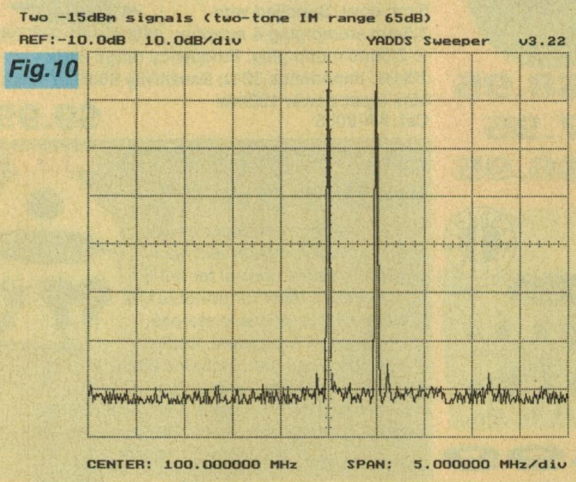


Fig.10

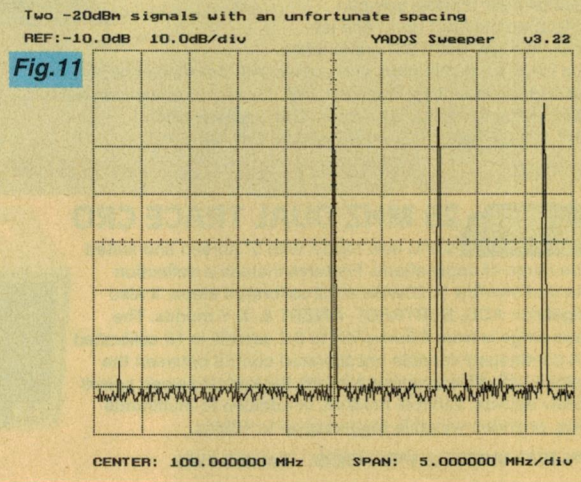


Fig.11

leaving the identification of real versus spurious responses to a well-trained human eye...

Finally, the software suppression is not foolproof. If two signals are spaced by a frequency such that the spurious signals generated by them fall to the same frequency in the two sweeps, this spurious response is not rejected. This happens for example if the signals are spaced 22MHz apart, as shown in Fig.11.

What is the purpose of a spectrum analyser with all these limitations, you might ask? Well, for one, it comes for free — the purpose of the heterodyne front end is to provide good dynamic range and accurate, calibrated four-pole swept measurements; the spectrum analyser display is a bonus.

Secondly, the frequency range that is covered by such an instrument is exactly the range of interest if a more conventional spectrum analyser is being constructed. Namely, to cover frequencies from DC to 500MHz with a spectrum analyser, a first IF of around 600MHz and a VCO operating from 600MHz to 1100MHz would be required. Both these can be accurately tested with a unit similar to the one described here, fitted with UHF PLL modules.

The same modules could later be used as the first local oscillator and tracking generator LO. Thus, it may be appropriate to call the unit described here a 'bootstrap' spectrum analyser.

With this, the groundwork to design a full DC to 500MHz spectrum analyser with a tracking generator is set — stay tuned for further developments!

Parts, availability

The YADDS generator, YAPLL modules, heterodyne front end kits, additional small bits and pieces, and the required DDS Sweeper/Pro software are all available from Tibor Bece, PO Box 1379, Sunnybank Hills 4109. Please send a SASE for the latest price list.

A demo version of the YADDS Sweeper software, suitable for driving the RF and Audio DDS sweep generators, is available from the EA BBS as DDSWP10.ZIP. This packet also contains the readme file that relates to the full version.

Notes & Errata

On some combinations of PCs, printer port cards and interconnect cables the VHF sweeper did not work reliably, producing random spikes on the screen or losing track occasionally. This was tracked down to crosstalk between the signal lines of the printer cable, which in turn caused spurious load pulses on the DDS and PLL modules.

The easiest way to fix this is to solder parallel 220pF capacitors to each of the resistors connecting the printer port lines to ground (4.7k on YAPLL, 1.5k on YADDS), on every module. These capacitors can be added on the bottom of the PCB, or on the top.

Also note that in the April 1997 article, the block diagram suggested to disconnect the YAPLL module Vcc if the PLL module is not used. This is in fact wrong, as the 74HCT14, left without supply voltage, will heavily load the printer port data lines.

The correct solution is to use a transistor driven from one of the spare control lines to clamp the series regulator transistor base (Q1 on the PLL modules) to ground. The same applies to the receiver LO PLL as well. With this arrangement the 74HCT14 and the MC145170 remain powered up all the time; only the VCO power supply is removed. ❖

Jaycar ELECTRONICS OCTOBER SALE

Prices valid until 31st October 1997

VIDEO DOORPHONE

NEW

See who is at your front door before opening it! You simply can't be too careful these days. When a visitor presses the doorbell, the video monitor automatically turns on, and you can see who is at the door. You can talk to them, and if you don't know them, ask them their business, without opening the front door. With the optional door release, you can remotely open the front door, and let the visitor in if you wish. The camera has IR LEDs for night illumination, and comes with installation hardware for flush or surface mounting. Supplied with clear instructions can easily be mounted by the family handy person. One year warranty.

DOOR RELEASE TO SUIT $34.95 Cat. QC-3415

Cat. QC-3410 **Only $469**

MAXELL GOLD RECORDABLE CD'S

Best price in town? 74min, 680mB. Cat. XC-4710

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Only $8.95
10+ $7.95
100+ $6.95

TV HEADPHONES WITH VOLUME CONTROL

NEW

Lightweight headphones especially suited to watching TV, and not disturbing others around you. Has inline volume control for left and right speaker, and long 5 mt. cord. Supplied with 3.5mm stereo plug & adaptor to 3.5mm mono plug. Frequency range 20Hz - 20kHz; Impedance 32 Ω; Sensitivity 96dB at 1kHz; Max input power 100mw

Cat. AA-2005 **$9.95**

Jaytech 25 MHZ DUAL TRACE CRO

NEW

WARRANTY 1 YEAR

Brand new model with 5" screen and suited to a wide range of applications. Features include a deflection coefficient of 5mv/div to 20V/div in 12 calibrated steps. It also gives algebraic ADD, SUBTRACT, INVERT & X-Y modes. The time base range is from 0.5µsec/div to 0.2 sec/div in 18 calibrated steps. A continously variable uncalibrated control between the steps, along with X5 expansion extends the fastest sweep speed to 40nS/div approx. Variable hold/off, in addition to multimode triggering, provides versatile triggering up to 40Mhz.

SUPPLIED WITH 2 PROBES. Cat. QC-1900 **$699**

EARPHONES WITH VOLUME CONTROL

NEW

These earphones incorporate an anti-sound leak design and have a separate volume control for left & right speaker. Ideal for portable CD players, Hi Fi's, portable stereos, or other audio equipment. Using a 3.5mm stereo socket. Includes 2 free earpads. Frequency range 12Hz - 20kHz; Impedance 32Ω; Max input power 40mW; Cord length 1.2 mts; Plug 3.5mm gold stereo.

Cat. AA-2017 **$6.95**

INVERTER MONTH

12VDC TO 240V AC INVERTERS

SAVE BIG $$ THIS MONTH See 1997 Cat page 85

140 WATT
Cat. MI-5036
Was $99.95
Save $20.00
Now $79.95

200 WATT
Cat. MI-5038
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Save $30.00
Now $129.50

300 WATT
Cat. MI-5042
Was $229.50
Save $40.00
Now $189.50

500 WATT
Cat. MI-5052
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Now $329.00

SPIRAL BINDING

KEEP WIRING TIDY! Are you sick of messy cabling behind your Hi Fi video or computer or TV? Spiral binding is available in 2 sizes, and is easily wrapped around buches of cables to keep them tidy. Colour is black.

NEW

6MM DIA 2.5 METRE
Cat. HP-1220 **$4.95**
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If the curly cord lead on your phone is always tangled, you need this product! It simply plugs into the handpiece, and rotates keeping the curly cord untangled. Made in USA. A quality product. Cat. YT-6075

NEW

$9.95

VIFA 2 WAY CROSSOVERS

Another surplus stock purchase. These have been designed for some old style Vifa kits. The SAX50 suited a 5" Vifa woofer and a D19 tweeter, & the SAX70 suited a Vifa 8" paper cone and D19 tweeter. The crossovers are mounted on a nice rear terminal which we sell for $5.25 alone. Both handle about 40 WRMS. Supplied with freq graph & schematic diagram. Limited quantity available.

NEW

SAVE ABOUT $25

SAX50 CROSSOVER FREQUENCY 3 KHZ Cat. CX-2609
SAX70 CROSSOVER FREQUENCY 4 KHZ Cat. CX-2608

Only $14.95ea

RF SHIELDED PHONE CASES

WHY TAKE THE RISK? We're not sure whether the stories you hear are true or not. Some people it seems, appear to get headaches from continual mobile phone use. Jaycar has sourced a range of genuine leather mobile 'phone cases to suit most popular models. So what? Well these cases have a special lead - yes lead - insert sewn into the lining of the leather case. This lead runs right across the earpiece (where your head is closest to the 'phone) and right around the base of the antenna where RF radiation is generally the greatest. If you are worried about the potential hazard from mobile 'phone radiation why not try one? At $29.95 it costs no more than a standard quality leather case anyway.

NEW

Microtac	Cat. HC-6920
Motorola 8200,8400	Cat. HC-6922
Motorola Flare	Cat. HC-6924
Motorola 8500,8700	Cat. HC-6926
Nokia 2110	Cat. HC-6930
Nokia 1610	Cat. HC-6932
Nokia 8110	Cat. HC-6934
Nokia 3110	Cat. HC-6936
Ericsson 318/388	Cat. HC-6938
Ericsson 738/788	Cat. HC-6940

Lead shield shown opened. Shield is simply wrapped around the antenna base.

Only $29.95 ea **Save $10**

NEW JAYCAR STORE IN BRISBANE

1322 GYMPIE ROAD. CNR ALBANY CREEK RD. ASPLEY QUEENSLAND
Ph: 3863 0099 Ph/Fax: 3863 0182

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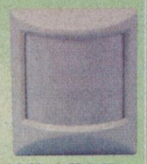
SUPER MOUSE 2

3 button mouse to suit IBM compatible PC's.
Cat. XM-5110
Cat. Price $19.95
Oct. $12.95
Save $7.00

MICRON PULSE COUNT PIR Cat. LA-5030



Normally $29.95
Oct. $25ea
Buy 5 $22ea

OPTIONAL LENSES AVAILABLE

LONG RANGE	Cat. LA-5031	$4.95
CURTAIN	Cat. LA-5032	$4.95

STETHESCOPE

Cat. QM-7255
Cat. Price $9.95
Save $3
Oct $6.95

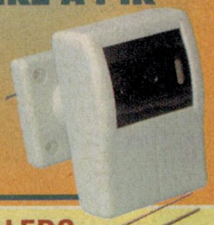
CLOCK MOVEMENT

Make your own clock, or fix your old broken clock.
Cat. XC-0100 **$9.95**

CCD MINI CAMERA

This mini camera comes in a black metal case that measures only 35(W) x 35(H) x 15(D)mm!! Unbelievably small. Supplied with mounting bracket and lead with DC socket and BNC socket. Requires 12VDC, and connects to any standard video input - like your VCR, or via an RF modulator to a TV aerial.
Cat. QC-3470 **Only $149.50**

"LOOKS LIKE A PIR" CAMERA



Includes infra red LEDs for night illumination.
Cat. QC-3450
$159.50

SUBWOOFER DEALS

Add a subwoofer/amplifier to your car sound system

Deal #1

AMPLIFIER New 4 x 50 WRMS
Bridge 2 channels together to give about 100W RMS to drive the sub, and that leaves 50 WRMS x 2 to drive your rear speakers.
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10" Polycone Re/Sponse
Cat. CS-2236 **$99**

SUBWOOFER CABINET
Supplied in knockdown form.
Cat. CS-2532 **$99.50**

Total $517.50
Save $78.50 - Buy together for $439

Add $50 for Carbon Fibre Woofer Cat. CS-2244

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AMPLIFIER
New 2 x 100 WRMS
Bridge 2 channels together to give about 200W RMS to drive the sub.
Cat. AA-0432 **$229**

SUBWOOFER
10" Polycone Re/Sponse
Cat. CS-2236 **$99**

SUBWOOFER CABINET
Supplied in knockdown form.
Cat. CS-2532 **$99.50**

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INFRA RED LEDS FOR CCD CAMERAS

$1.25ea or 10 for $10
Use our ZD-1945.
Specs are in the 97 Cat. P154. Cat. ZD-1945

2 WAY SPEAKER SWITCH

See 97 Cat. page 51 for more details.
Cat. AC-1640
Was $29.95
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Save $ 9.95

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Cat. ST-3100 **$39**
KEYRING **SAVE**
Cat. ST-3102 **$49**

POCKET SHIFTER MULTITOOL

HALF PRICE

Great pocket tool. Its a shifter (max jaw opening 18mm) and pocket knife type extras - phillips & slotted screwdriver, file, can opener, bottle opener, knife. Supplied in a holder with belt clip. Made in Taiwan. Cat. TH-1905
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Oct. $10

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See 97 Cat. page 161 for full details.
Cat. XC-5080 **Was $47.85**
Oct. $35 Save $ 12.85

SUPER BRIGHT 5MM RGB LED

Emits red, orange, yellow, green, blue and white. Specs: red 45mcD, green 15mcD, blue 3mcD.
Cat. ZD-1798
Cat. Price $9.95
Oct $6.95 Save $3

GOLD SPEAKER STANDS

See 97 Cat. page 49 for full details.
Cat. HS-8000
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INSTRUMENT SPEAKERS

See 97 Cat. P41.

10" 65WRMS
Cat. CG-2376
Was $57.50
Oct. $39.50 Save $18

12" 100WRMS
Cat. CG-2380
Was $99.50
Oct. $75 Save $24.50

BUY 10 LESS 10%

THE ROCK SPEAKER!

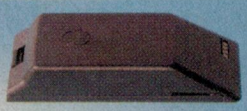
Looks like a rock.

Speaker is a quality 8" woofer and separate 2" tweeter Power handling 40WRMS. See 97 Cat. page 40 for full details.
Cat. CE-2300
Was $99
Now $69
Save $30

MICROTAC HANDS FREE KIT

Plugs into bottom of phone and cigarette lighter. Includes plug-in earpiece for private conversation if required.
Cat. YT-6105
Save Big $$$$
Cat. Price $69.95
Oct. $49.95 Save $20

MICROTAC NEW LI-ION BATTERY



Power Plus! When used with a 8400/8700 Motorola you get 120 hours standby and 540 mins talktime, and with a Microtac you get 40 hours standby & 150 mins talktime - and no memory effect Cat. SB-2572
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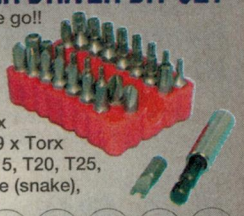
"FULL HOUSE" POWER DRIVER BIT SET



All the weirdo driver bits in one go!! -The set consists of 32, of the driver bits that you don't normally see. You don't get any slotted, Phillips or Posidrive bits. You do get: •4 x Tri - wing, size 1, 2, 3, and 4 •9 x Torx (tamperproof), size T8, T10, T15, T20, T25, T27, T30 and T35 •4 x Pin drive (snake), size 4, 6, 8 and10 •6 x In - Hex (allen), *metric, size 2, 2.5, 3, 4, 5 and 6 •6 x In - Hex (allen), *imperial size 5/64", 3/32", 7/64", 1/8", 9/64" and 5/32" •3 x Torque Set, size 8, 9 and 10. With this you get a hex driver with magnetic retainer, all in a nifty plasticy - rubber holder that is smaller than a deck of cards! (67 x 45 x 30mm). you will never get stopped by a wacko screw ever again!!
Save $8 Was $29.95
Cat. TD-2035 **Only $21.95**

SCOOP PURCHASE OF THE DECADE

AURA INTERACTOR

Plug it into computer games, stereos etc, then put the back pack on and feel all the low frequency sounds. See previous ads for full details. Cat. XC-1000

SAVE $210!

WAS $249
THEN $49.95
OCTOBER
$39.95

ARLEC SECURITY BEAM NEW

This security beam is ideal for use in shops, reception areas, factories, warehouses or any unattended doorway or entrance area. It uses an infrared beam, and a buzzer sounds when the beam is broken. Ideal range is 2 - 8 metres. Complete with mains adaptor.

Cat. LA-5190 **$195**

GME Kingray HI QUALITY MASTHEAD DIPLEXER

Allows you to connect both a UHF antenna and VHF antenna into the diplexer, then run 1 cable to the house. Mounts onto TV mast. Australian made.Cat. LT-3015

$22.95

NEW

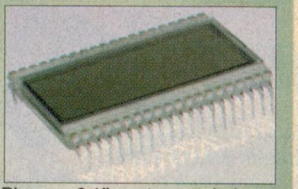
REMOVEABLE HARD DISC CARRIER + FRAME

NEW

Ever wanted to transport large amounts of information without using a Zip Drive or a CD ROM writer. Now you can without breaking the bank. Use any type of 3.5" or 2.5" hard disk between two PC's e.g. home & work. Quality made unit •Lockable cradle •Power LED + HDD usage LED •Fits a standard drive bay

IDE KIT Cat. XC-4670
SCSI KIT Cat. XC-4671 **$39.95ea**

LCD DISPLAY SURPLUS NEW



These are 4 digit 7 segment field effect LCD displays suitable for battery powered applications. Pins are 0.1" centres and plug directly into PCB or socket strips. 4 digit, character height 12.7mm. Display size is 50 x 30mm and pin spacing is 33mm. Limited quantity available. Normally around $14. Cat. ZD-1885

Only $4.95ea

GME Kingray 4 WAY MASTHEAD AMPLIFIER

NEW

These are Australian made, and are very good quality. If you have up to 4 TV's in your home, why not use a Masthead amp, then run a separate lead to each TV from the mast. This way you do not lose any signal through the splitters. Max. gain VHF 10dB/ UHF 12dB. Supplied with mains power supply.

Cat. LT-3292 **$110**

ARLEC DIGITAL TIMER

•Automatically switches lights or appliances on and off with up to 12 commands. •Daily 24hr programming •Weekday, weekend and 7 day programming •Random on/off and daylight saving 1 hour advance. Arlec brand.

NEW

Cat. XW-0402

Only $47.95

11 DIGIT FLUORO BARGAIN

NEW

Vacuum fluorescent displays - still look the best. Once again Jaycar has purchased a substantial quantity of a quality Futaba brand vacuum fluorescent displays. Each digit measures 6.0mm(H) x 3.5mm(W), 11 digits in all. The display also features an apostrophe in the top right hand corner of the digits, and a semicolon (;) in the bottom in all 11 digits. Electrical and mechanical data is incl in the price.

Cat. ZD-1880 **Only $4.95ea / 10 up $4.40**

Not to forget! Allegro brand UDN6118A Driver IC

Cat. ZD-1882 **Only $4.95 10 up $4.40**

PIHER HORIZONTAL TRIMPOTS NEW

Features: •Dust proof enclosure •Polyester substrate •Wiper positioned at 50% •Accidental rotor movement protected. Specifications: •Max voltage 100V •Nom power 0.1W •Linear curve •Tolerance +/- 30% •End resistance 10Ω.

Value	Cat#	Value	Cat#
200Ω	RT-4350	20K	RT-4362
500Ω	RT-4352	50K	RT-4364
1K	RT-4354	100K	RT-4366
2K	RT-4356	250K	RT-4368
5K	RT-4358	500K	RT-4370
10K	RT-4360	1M	RT-4372

All One Price 70c ea

BEST QUALITY 6.5MM PLUGS

NEW

These use the same high quality aluminium case as our best quality RCA plugs. Plugs are gold, and available in both mono and stereo. Cable entry diameter is 6mm.

MONO	RED	Cat. PP-0151
MONO	BLACK	Cat. PP-0152
STEREO	RED	Cat. PP-0177
STEREO	BLACK	Cat. PP-0178

All Only $4.50ea

12V DIL LATCHING MINI RELAY

AVAILABLE ONCE AGAIN!!

NEW

DIP style - will plug into 16 pin IC socket. Low profile mini 12V 2 coil latching relay. Highly sensitive - 400mW nominal operating power.

Specifications Coil • 2 coil latching • 12 volts DC • Minimum set and reset power 180mW • Nominal set and reset power 360mW

Specifications Contact • Max switching power 60W, 125VA • Max switching power 220V DC, 250V AC • Max switching current 2A AC/DC • Max carrying current 3A AC/DC • Size 20x10x 10(H)mm

Cat. SY-4060 **$9.95**

RESPONSE PRO MIC CABLE

The best quality microphone cable for all P.A. and stage use. Super flexible black matt finish PVC low noise cable with tinned copper shielding.

2 CORE SHIELDED

NEW

Cat WB-1530
Specs: 24/0.20 x 2 core + 112/0.12
Colour: red & white conductors. Outer dia: 6.5mm

$2.20 / mtr or $150 / 100 mtr roll

4 CORE SHIELDED

NEW

Cat WB-1540
Specs: 11/0.20 x 4 core + 112/0.12
Colour: red,white,yellow & black. Outer dia: 6.2mm

$2.75 / mtr or $192 / 100 mtr roll

SINGLE SHIELDED CABLE

This is in our catalogue as Mic cable, but does not have a cotton filler. It can be used as audio cable, or wherever a single shielded cable is required. Specs: Lead with wire 7/0.12mm, shield 28/0.12mm, OD 4.6mm, colour - black.

Save Big $$$$

Cat. WB-1520

Cat. Price $1.70m
$116/100m roll.
Oct. Price 80¢ m
$40/100m roll.

HIGH BRIGHTNESS BLUE LED

NEW

Wow! This is the brightest blue LED we've ever seen! 650mcd at 3.6V. Size is 5mm.

Cat. ZD-1797 **$9.95**

5 AMP NOISE SUPPRESSOR

NEW

Easy to use noise suppressor for car stereos. Connects in power lead before stereo. Features gold plated terminals and housed in round plastic case. Three wire connection. Cat. AA-3050

Only $12.95

20 MT. ROLL OF MONITOR OFC SPEAKER CABLE

NEW

Save 75c per mt. over buying from a big reel. Supplied on a plastic reel.

Cat. WB-1736 **Only $69.00**

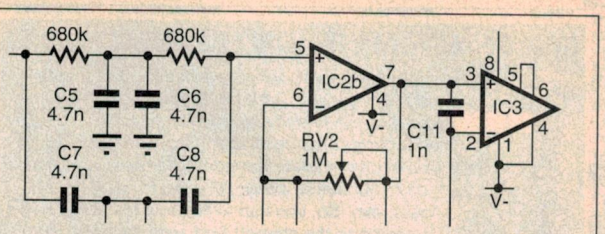
JAYCAR WHOLESALE

All Jaycar products are available at very competitive wholesale prices. If you are tired of your current unreliable supplier, why not give Jaycar a try. You'll be pleasantly surprised.

MAIL ORDER - FREECALL FOR PHONE ORDERS 1800 022 888

$10 Wonders

by OWEN BISHOP



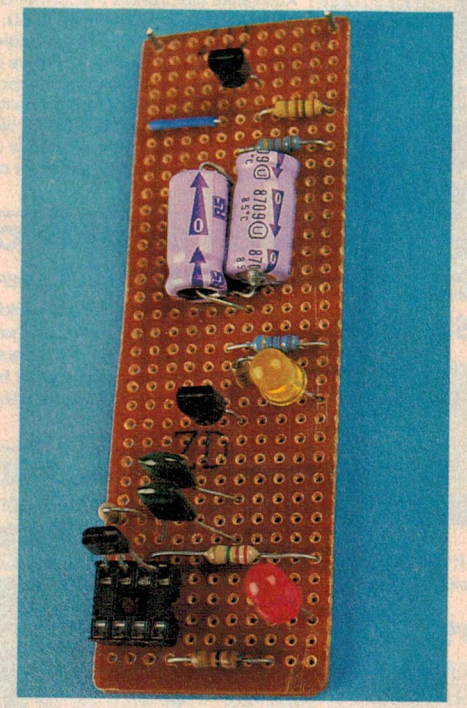
6 - Transistor Tester

This little project costs well under our $10 limit but is a useful device to have around on the workbench. It was originally designed for testing MOSFETs, but it can also be used for testing JFETs as well as bipolar junction transistors ('ordinary' transistors, to the uninitiated!). It works equally well with N-channel and P-channel enhancement MOSFETs and with both NPN and PNP transistors. It also has one or two other applications, which we shall mention as we go along.

This is a simple go/no-go tester and you could do the same testing by using a few clip leads, a battery and a multimeter; but having this test rig handy makes the testing much less fiddly and more reliable.

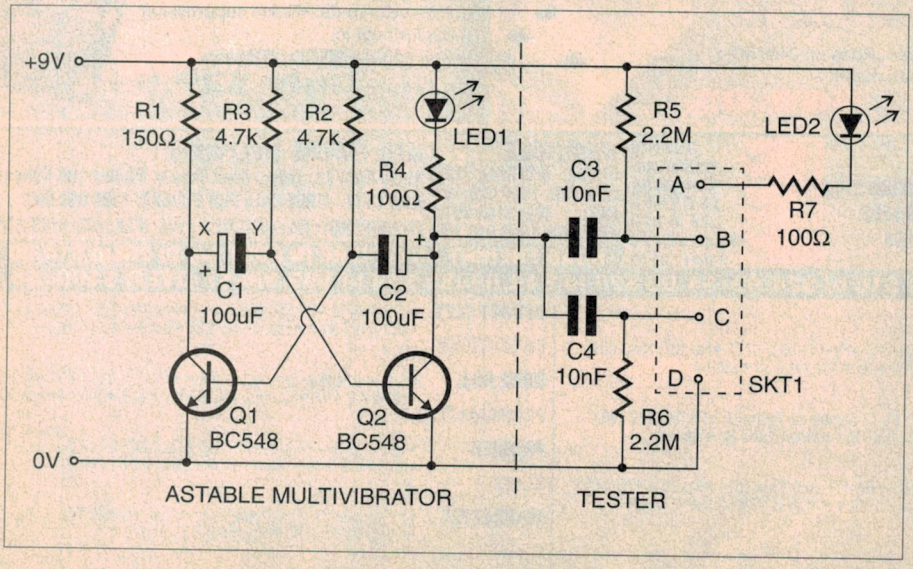
The main part of the circuit (Fig.1) is a traditional astable multivibrator. This is a circuit which has two states and which continually flips from one state to the other and back again. In other words, it is a kind of oscillator that has a square-wave output, and we use it for switching the test transistor on and off repeatedly. It works by alternately charging and discharging a pair of capacitors (C1 and C2), and the time taken to do this depends on both the values of the capacitors and the values of R2 and R3. With the values given in Fig.1, it takes about one second to run though a complete cycle of operation.

The oscillating action works like this. Suppose we start with transistor Q1 having just switched on. This lets a current flow through R1, and so a voltage is produced across this resistor which pulls the collector of Q1 down to a little more than 0V. A sudden drop in voltage at terminal X of C1 causes an equal sudden drop at its other terminal, Y. This reduces the voltage at the base of Q2 and turns it off. Now current flows through R3 to restore the voltage at Y.



As already mentioned, the time required to do this depends on the values of C1 and R3. Gradually the voltage at Y rises to about 0.7V and becomes enough to begin to turn Q2 on. As Q2 turns slightly on, the voltage at its collector suddenly falls, and this voltage drop passes through C2 to the base of Q1. This turns Q1 off. Up goes the voltage at its collector, up go the voltages at X and Y and at the base of Q2, turning Q2 fully on. Now Q1 is off and Q2 is on, and current is flowing through R2 to recharge C2.

The circuit has reversed its original state, but as current flows though R2, the voltage at the base of Q1 gradually rises. Once it reaches 0.7V, Q1 starts turning on and the process repeats, turning Q2 off and Q1 fully on. As long as power is supplied to the circuit, the transistors are switched on and off alternately. There is an LED in the collector circuit of Q2, so this is flashes on and off as Q2 turns on and off.



LED flasher

A flashing LED is an effective attention-getter and you can use this project for this purpose as well, as or instead of using it for testing transistors. You

Fig.1: This tester will check MOSFETs, JFETs as well as normal transistors. It's split between a monostable multivibrator on the left, and the testing circuit on the right.

could leave it on top of the VCR as a reminder to set up a recording of your favourite TV program.

You could even fix it to the kitchen notice-board to draw attention to something you want everyone to know about. To make it even more effective, replace R1 with a second LED in series with a 100Ω resistor. The two LEDs will now flash alternately. This circuit could be used on a model railway to simulate the flashing lamps at a railway crossing barrier.

Another variation is to replace R3 by a 10k trimpot in series with a 470Ω fixed resistor. These values allow you to set the oscillator to run at exactly 1Hz, making a handy seconds-counter or timer.

Transistor tester

Getting back to our tester, it has an 8-pin IC socket, which is an inexpensive way of connecting most small-signal transistors into the circuit for testing. As each of the two columns of sockets are wired in parallel, you can use either the left-hand or the right-hand set of sockets for the transistor.

For testing an N-channel enhancement-mode MOSFET (nearly all of them are of this type), push the drain terminal into socket A, the gate into C and the source into D. In the description below we assume that you are testing this type. The table shows how to connect other types of transistor.

The output from the astable goes to a pair of capacitors C3 and C4. When Q2 switches off, a high (approx. 9V) voltage appears at its collector, causing a high level to pass through C4 and temporarily raise the voltage at terminal C of SKT1 (the gate of the MOSFET). This lasts only a fraction of a second because current is conducted to ground through R6; but the pulse is long enough to turn on the MOSFET (supposing that it is not a dud). The MOSFET conducts, current flows through it and LED2 flashes. Note that this happens as Q2 goes off — that is, as LED1 goes out. The flash is short but easy to see, and confirms that the MOSFET is working.

For a P-channel enhancement MOSFET the polarities have to be reversed (see table), which means that source and drain have to be swapped around, and we need a negative-going pulse to turn on the transistor. This is provided by terminal B of the socket.

Depletion-type MOSFETs would probably work too, but since they seem to be unobtainable (or even not manufactured?) we have not been able to check this.

JFETs, both N-channel and P-channel, respond to the testing in the same way. Although an N-channel JFET operates with a negative gate voltage and turns on before it rises to 0V the capacitive coupling between the astable and tester sections provide the signals needed.

Bipolar transistors will also work, but since they conduct current away through their base terminal the pulse is short-lived and the flash is very short. Power transistors have appreciably smaller gain, so you might have difficulty in seeing the flash in a brightly-lit room.

Construction

Build the astable first (all of Fig.2 to the left of column 25), noting that the strips are cut beneath the board at E13, F13 and C28. Check the connections of C1 and C2, making sure that their bare leads are not touching. Also make sure that LED1 is mounted the right way round, and then solder a battery clip to the two terminal pins. Test the assembly so far by inserting a 9V PP3 battery in the clip (you could use a 6V battery if you prefer). LED1 should flash on and off about once per second. Complete the circuit, remembering NOT to cut the strips beneath the IC socket. ❖

Transistor connections to SK1

Socket	MOSFET/JFET		BJT	
	N-chan.	P-chan.	NPN	PNP
A	d	s	c	e
B	-	g	-	b
C	g	-	b	-
D	s	d	e	c

PARTS LIST

Resistors
(Carbon 5%, 0.25 watt)

R1	150Ω
R2,R3	4.7k
R4,R7	100Ω
R5,R6	2.2M

Capacitors

C1, C2	100uF electrolytic, 16VW
C3,C4	10nF polyester or MKT

Semiconductors

LED1, LED2	5mm LED, any colour
Q1,Q2	BC548 transistor (or any small-signal NPN type)

Miscellaneous

SKT1 8-pin DIL IC socket
One piece of matrix stripboard 30mm x 90mm (11 strips x 35 holes); 1mm terminal pins (2 off); PP3 battery clip.

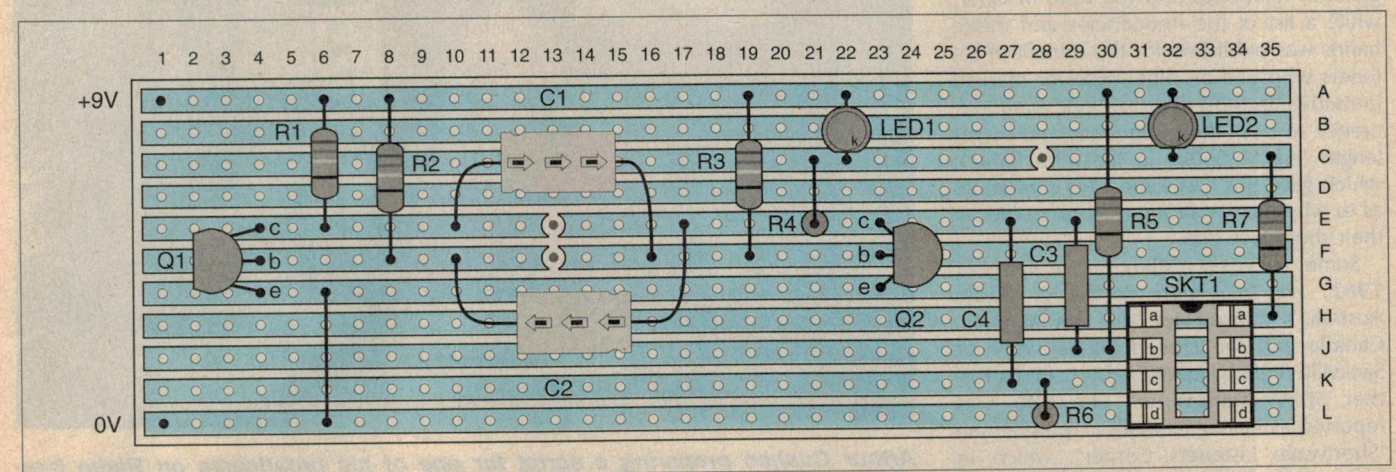


Fig.2: Above is the parts overlay diagram for the tester. You might use a piece of spaghetti sleeving to make sure that the leads of C1 and C2 don't touch.

SHORTWAVE LISTENING

with Arthur Cushen, MBE

Milestones in Shortwave Listening

This month marks another historic milestone for our magazine, as it is now exactly 45 years since Arthur Cushen began contributing this popular column. To celebrate the occasion, we invited Arthur to provide a larger than usual column, discussing the developments that have taken place in the field of shortwave broadcasting — and listening — over the last 45 years. Here's what he came up with...

It was in October 1952 that this column first appeared and over the past 45 years there have been tremendous changes in shortwave listening. Not just in terms of the types of transmissions, receivers and aerials, but even the references to frequencies and times have had new designations.

Looking back to that first month's column, the highlight was a report on Radiodiffusion National Belge, of PO Box 26, Brussels, Belgium which had been officially opened on August 1, 1952. The Brussels station, using the callsign ORU 'The Goodwill Station', had absorbed the programmes of the popular station OTC, at Leopoldville, in what was then the Belgian Congo.

Over those 45 years little has changed at Brussels, but Leopoldville is now Kinshasha, and the country is now the Democratic Republic of Congo.

Another piece in that first column was the report of an interesting signal from Colombo, the commercial service of Radio Ceylon, which continues today under the country name of Sri Lanka. Of course, in those days reference to the frequency was given in kilocycles and the time in GMT, while a list of the frequencies and metre bands was published for the benefit of listeners who had an older receiver marked in metres. In most cases stations made reference to both their frequency and wavelength (e.g., '6050kc in the 49m band'), which gave the newcomer two references as to where the station could be found on their shortwave dial.

Some 10 years further on, in October 1962, we published details of Radio Australia's transmission to Latin America, Canada and the United States, while at Sackville Radio Canada had installed a further 50kW transmitter. The BBC was reported as having its mailbox programme 'Shortwave Listeners Corner', which in later years became 'Waveguide' with Simon Spanswick. A new country was reported, South West Africa with Radio Windhoek and here again, there has since been a change of name — to Namibia.

When we move on a further 10 years to 1972, Canada had installed 250kW transmitters; we have moved to kilohertz from kilocycles; Liberia station ELWA was reported, while the first private commercial station in the United States since the war, WINB in Red Lion, PA had made a frequency change. Also the name of the column was changed to 'Listening Around the World', from the old title 'On Shortwave'.

In 1982 the title of the column was changed again to 'Shortwave Sound' and we were celebrating 30 years of its publication. We had also moved from GMT to UTC. In the pages we were discussing World Communication Year, sponsored by the United Nations, which was to be held in 1983.

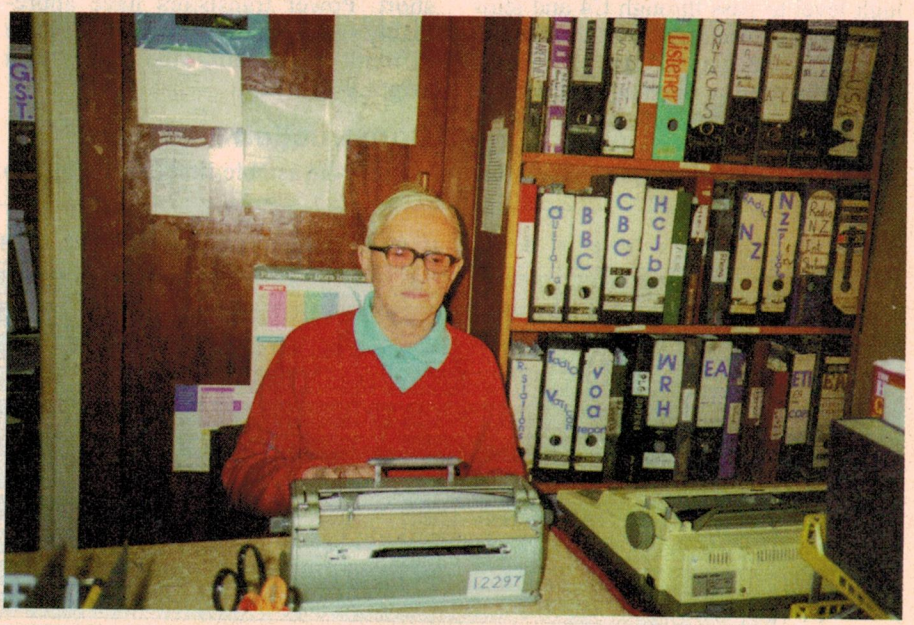
There had been tremendous changes in the previous 10 years. Satellite linkage between studios and distant transmitters was common; Sony had introduced the 'keypad' receiver in 1980, which revolutionised shortwave listening with its digital readout and ease of locating stations. We also recalled that in 1952 I had verified 906 broadcast verifications and 1455 shortwave verifications. Today, the total stands at 3015 on the broadcast band and 6600 on shortwave, from 301 countries.

The major news 10 years later, in 1992, was the increased use of the exchange of facilities. For instance, Radio Japan's transmissions were being relayed by the BBC, and this is now undertaken by most international broadcasters. The Soviet Union had disintegrated and new countries were appearing across Europe and Asia, while the first broadcast from Hawaii was observed when KWHR commenced operating on shortwave.

This was not strictly the first broadcast from Hawaii, as during the war years KRHO was frequently heard carrying Voice of America programmes. Tonga, which operated a shortwave service in the tropical band was put out of operation by a hurricane and the transmitter has never been replaced.

In 1992 the future of Radio Australia was in doubt as the Government had proposed budget cuts which would mean a reduction in ABC funding — likely to affect the Radio Australia service.

When we look at shortwave broadcasting today, despite the increasing use of computers carrying real audio signals into homes, there are major broadcasting operations still continuing. The BBC has recent-



Arthur Cushen preparing a script for one of his broadcasts on Radio New Zealand International or Radio Nederland, using a Perkins brailler. The office files have both print and braille identification for easy location.

ly released details of an increased audience to their services; the Voice of America has established new transmitters in Thailand and on Sao Tome and later this year, in the Central Pacific; the BBC's new relay base in Thailand is in operation, replacing the former transmitters in Hong Kong; while many Russian transmitters formerly used for jamming are now carrying programmes as a rebroadcasting link into Asia for many European stations.

Radio Nederland continues to be the highest rated shortwave service, for its involvement in a wide variety of programmes, and its Media Network Thursday release has for some time been voted an outstanding session for those interested in the world of communication.

Threatened changes in shortwave transmission have not eventuated. Presumably most broadcasters are wary about taking any major steps in this direction as they realise any new technology would mean the loss of their huge audiences in Asia and Africa for shortwave services.

There is much involvement in the radio listening field in the use of computers, fax and email, which certainly speed information across the world. But there are still many who are traditional shortwave listeners and have not been able to move into some of these new areas. In my case blindness means I am dependent on listening to put together this column every month.

When I look back on the past 45 years, I must thank the editors over the years for their support and co-operation, the staff at *Electronics Australia* and of course the many readers who contact me with questions, advice and news of what they are hearing. That whole mix, for me, is the satisfaction that one gets from contributing this feature every month.

The receivers used

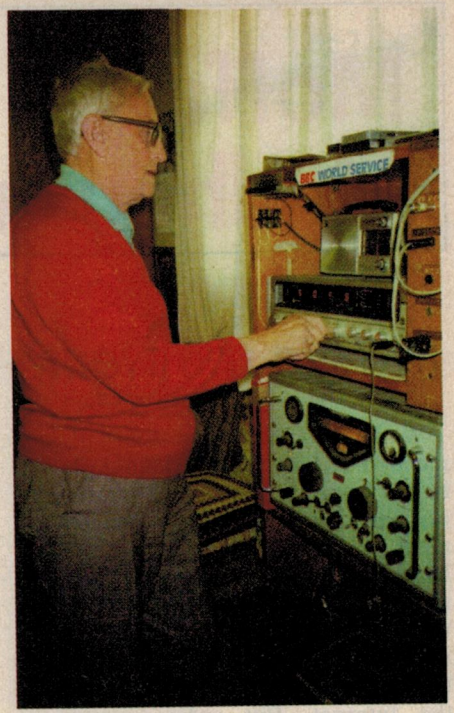
Over the past 45 years there have been many changes in receivers and aerials and I have always tried to give reports reflecting the listening conditions typical of the domestic radio listener, particularly in the field of monitoring. It is only when I am working in the DX side of the hobby that I have used communications receivers.

When this column was started I was using an English Ekco receiver which I purchased in 1939. It had seven tubes (valves), had a large square dial and pointer and the dial listed some exotic stations like Mafeking, Capetown and the like. It still has pride of place in my lounge room — it's a beautiful piece of equipment and the cabinet is an excellent piece of craftsmanship.

My first communications receiver was a Hallicrafters SX28, followed by a National NC190 and several other Hallicrafters receivers. Then I purchased a Racal RA17 which is still in operation and my only tube receiver in use. The last tube receiver I purchased was an Eddystone 840A.

Since 1980 I have moved into keypad operation, following the Sony marketing of the ICF2001, which for a blind listener gave a tremendous degree of independence. It is still in use in the office after 17 years. Then VOA offered me an ICF2010 for monitoring work; this is a widely used receiver and has certainly given me a wide coverage. It's a receiver that today is still highly rated.

In the old days with an analog dial I had to find my way across the band by reference to local mediumwave stations on the mediumwave band and going down two or three bands to a frequency which I knew as a reference point to start listening. Today, I am also using a Philips 299D and a McKay Dymec.



Arthur with two of the communications receivers used for DX listening at his listening post. He's tuning the McKay Dymec DR22, with the Racal R17 visible on the shelf below.

The McKay Dymec is a difficult receiver to operate; it has four knobs, as seen in the illustration. From the left these give you the 10,000kHz position, then the 1000s, then the 100s and finally the right-hand knob which has 20 positions on it. The latter is difficult to operate as it indicates each 5kHz from 0-95, giving the last digits of the frequency you wish to tune. If in doubt I go back to WWV and at that point all the marks on the knobs are in a zero position.

The 2010 has been on the market for several years and still has a high reputation as the leading portable of its type.

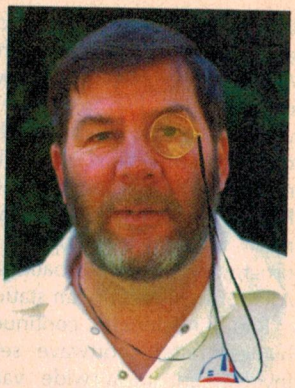
The Racal has a knob on the right which sets up the megahertz and on the left a knob for the kilohertz. The dial reads from 0-1000, but it has a built-in tone every 100 kilohertz which makes it easy to find stations on the dial. This receiver is generally used for monitoring, when we have to do a band for Radio Canada each month. We check all the signals audible, their strength, location and times of transmission; this data is transferred onto a graph which has the times

(Continued on page 89)

Jonathan Marks of Radio Nederland's Media Network interviewing Arthur Cushen at the Montreal Convention in 1986.

Moffat's Madhouse...

by TOM MOFFAT



Is This the Death of Ham Radio?

Well, that woke you up, didn't it! Any mention of ham radio's demise always brings howls of rage from its practitioners, aimed at the magazine, the government, the CB'ers, or pirate operators, or hams who have got bored and given it away — or all of the above. So perhaps we'd better, er, moderate that a bit. Ham radio is not being destroyed, it is just being *augmented* by some activities on the Internet. But radio proponents should certainly be looking over their shoulders, because, as the old saying goes 'the writing is on the wall'...

I wonder how many of you have discovered, as I have, that the Internet lets you do the stuff that has for many years been the exclusive domain of licensed radio amateurs — talking with people on the other side of the world. Voice transmission is possible, but rare. The big thing just now is the Internet equivalent of radioteletype, generally referred to as 'chat'.

I have closely followed the development of the chat scene over the past few months. Early on, chat wasn't part of the World Wide Web; you had to use the pre-web Telnet protocol to log on to a big bulletin board system, just like those that were so common before the Internet came into existence.

You were then presented with a very computerish-looking text screen. After logging in you'd get a menu from which to select by keying in numbers. Not mouse-friendly at all. Upon selecting a 'chat room' you'd see a screenful of comments from a large number of people. Every few seconds it was necessary to give a command to update the screen, and then more comments would appear on the bottom, and older ones would scroll out the top. And of course, you could add your own two-cents worth into the growing pile.

This was much like a large crowd of people standing in a big room yelling things. Sometimes in answer to other comments, other times just random thoughts. Everybody could read everything; it was very public. But it was possible to send a comment to a particular person in the room, in a manner which prevented the others from seeing it. These little exchanges almost always took place between members of the opposite sex, and thus was born (let's be honest!) the real reason for chat's existence.

Compare this with ham radio: The equivalent of the Internet public chat room is the 'net', a gathering on the air of a sizable group of men, or of women, but seldom both at the same time. Most discussion is of a radio nature (which by law, is supposed to be the case), who 'worked' whom on what band, and how's my new antenna going. From time to time, two members of the 'net' will move off to another frequency to discuss personal matters, such as how ol' Percy's recovering from his most recent heart attack...

On the Internet, a lot of effort has been expended to make chatting quick and easy. Probably the most popular form of chat nowadays is under a system called IRC, for Internet Relay Chat. There must be millions and millions of people doing this all over the world, every one potentially able to contact every other.

This takes place through hundreds of 'servers', which are nothing more than enormous repeaters, like the ham two-metre boxes on mountaintops. There is no longer any need to refresh the screen; the text just flows along like words on a roll of teletype paper. All you need to get on IRC is an Internet connection and a special software package — I use one called mIRC.

On any IRC server there can be thousands of 'channels', analogous to individual frequencies on the ham bands. But IRC presents you with a list of channels, describing the topic being discussed on each of them. Some of the stuff, as you can imagine, is pretty raunchy, and it's brought chatting a rather bad name in some circles.

Since this is a family magazine I won't be too specific — perhaps this recent quote from the feminist magazine *Ms.* will enlighten: "For the moment, some of the most flagrant forms of male domination seem to flourish on the Internet because men, by sheer force of their numbers, dictate the tone and content of what occurs... Perhaps virtual rapists represent patriarchy's storm troops...". Well, you get the idea.

But Internet chat is just like television; it has its good programs and its bad programs. I have found that the level of decency seems to be proportional to the age of the users (sorry kids..). Channels of the '30 plus' variety behave much more like a cocktail party. There are men, and women, discussing any topic under the sun. Every now and then someone will crack a joke, but since everything is written it is necessary to respond with a code such as *LOL*, meaning 'laughs out loud'. This all becomes very natural with use.

Just like on CB radio, people on chat have 'handles': stage names. As well as words, you can describe actions, which appear on everyone's screen in a different colour from the speech. For instance: "TasDevil looks deeply into KittyKat's eyes". A few moments later, between the chat, another action message appears: "KittiKat returns TasDevil's gaze, smiling gently..."

As the evening progresses, certain participants might feel the desire to know each other better, and it only takes a click of the mouse to signal the other person that you would like to get a little more personal. She seldom refuses; after all, that's what she's here for. So the two of you go outside together for a breath of fresh air, your own one-on-one chat. Totally alone.

Once in a private setting with a new companion, it is time to exchange 'stats', your personal statistics. Gender is of particular importance, because handles are sometimes vague in this regard. It would be a pity to discover that the lady you've just spent the last hour sweet-talking isn't a lady at all...

The nice thing about written communication is that you get to know the other person from the inside out, instead of the other way around (see Moffat's Madhouse Dec.96, about flirty e-mails). You haven't any idea what she/he looks like, but a rapport is likely to develop between your minds, and maybe even your hearts.

Within the private setting, real names are revealed, as well as age, marital status, and where you live. It is quite possible the two of you can be on opposite sides of the continent, but become very close though the medium of chat. It's nice to know if a future personal meeting is possible.

One can, of course, fake it. Here I am, the wrong side of 50, covered with the battle scars of life and too much good food. By simply fiddling with my stats I can become 20 years younger and 50 pounds slimmer. I am told a lot of this goes on. And it seems men are the most blatant offenders. Women tend to keep their stats deliberately vague, with details to be revealed bit by bit only as the situation develops.

The real proof of the puddin' is a photograph. The mIRC software and most other modern chat-gadgets let you transfer a file directly to your new friend's computer. Here's where a digital camera really comes in handy, and I've spent a lot of time using mine to churn out digital photographs for friends who keep them ready for instant transmission should the situation warrant.

Vanessa McGrady runs Limelight Introductions, a service that brings together men and women in the real world, rather than the computer world. She is the American equivalent of Yvonne Allen. In this violent society of ours, with its mad rapists and serial killers, are people courting danger by meeting on the Internet, and then meeting in person?

"I say, do something easy, really simple, informal. Go to get coffee, go window shopping, go to the beach, go to an amusement park. And then if you get a bad vibe from that person, and if your intuition tells you something's not right with that person, then certainly don't go out again."

Here in Washington state, one of the Internet Service Providers has its own chat line which is used extensively by locals, with occasional visitors from further afield. My first encounter with chat was when I was working on a magazine article, and trying to find the location of a suburb called Richmond in British Columbia, Canada. I thought the Port Angeles ISP was close enough to BC that someone on their chat line would surely know. (It turned out to be just south of Vancouver.)

An electronic snap of the members of the Sequim Internet Ladies Highway 101 Diner Luncheon Club, at a recent luncheon. No prizes for picking Tom, the first official male member...

During this visit I was befriended by someone called Buttermilk, who wanted to know who I was and where I was and what I thought about life in general. Later Buttermilk's friend Bubbaloo turned up, and still later a lady called 3Blairs arrived. All of them lived in the Sequim/Port Angeles area about 60km west of here.

After a few more visits on the Port Angeles chat line, these ladies decided I must be trustworthy. So they invited me to their regular Friday afternoon get-together, at a 1950's style restaurant in Sequim. I had never before experienced a face-to-face meeting with an online acquaintance, and now I was going to take on three of them all in one whack.

I must have got to know these ladies pretty well, just through their words. When I finally got the courage to walk through the door, I immediately knew which was the right group, and I even knew which woman was which — just from spending some time typing back and forth on computers. Now I am the first official male member of the Sequim Internet Ladies Highway 101 Diner Luncheon Club, and I've joined them every Friday for the past two months.

We are now the greatest of friends, and as well as lunching together we still spend a couple of hours a week together — chatting on the Internet. Another spinoff comes when I check my morning e-mail; usually there are cheery messages from these ladies, containing jokes. You can tell that some of the jokes have been passed from person to person five or six times. It looks like there is a whole new movement building up within e-mail: Joke Net! But that's another story... ❖

ALTRONICS COMPONENTS

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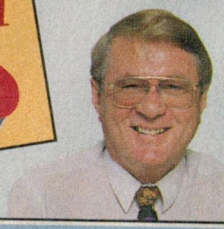

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Best Regards,
Jack O'Donnell, Managing Director *Jack O'Donnell*

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"This has all the convenience features of a normal butane iron, such as quick heating, no power cords, light weight and best of all, it comes with a blow torch tip." **Silicon Chip Magazine, Sept '97**

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Fantastic Value! *3.75 digit DMM with bargraph & autoranging! Includes rubber holster & test leads!*

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Solder Roll BARGAIN!

OOPS! This solder is a 40/60 mix of tin/lead, instead of the regular 60/40. We've tested it, and it solders just fine! Stock up at fantastic rates and keep some handy in the workshop! *Available in 0.8mm or 1mmØ sizes.*

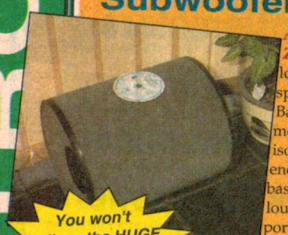
T 1100A 0.8mm Was $6.50 a Roll, NOW **$3** ea,

T 1110A 1mm Was $6.25 a Roll, NOW **$3** ea,

or Buy **5** Rolls for **$12** (mixed sizes OK!)

What a Super Deal! *Stock up on solder at a bargain price!*

The BASS BARREL Subwoofer Kit



You won't believe the HUGE sound from such a little speaker!

As featured in Silicon Chip & ZOOM August '97! If you're looking for big bass without big speakers, look no further than The Bass Barrel. Features compound-mount dual 6.5" drivers in a 20 litre isobaric, vented bandpass enclosure to provide deep, strong bass without taking up half your lounge room! Kit includes drivers, ports, terminals, wire, wadding, baffle and end pieces, screws, and the tube used for the enclosure. The subwoofer handles 150W and frequency response extends down to a thumping 30Hz. It's the ideal bass solution for hi-fi, home theatre and car audio. *Carpet and trim not included, see your local auto trimmer's for your preferred trimming colour and texture.*

C 3220 Subwoofer Kit **$199**

12" Subwoofer Driver

Just the shot for adding some wallop to your hi-fi, car audio, or home theatre system. This 300mm 8Ω sub driver features a super-rigid Poly Emulsion Coated Cone (PECC), with a high-efficiency foam surround, low-Q & low resonance . Does the business in vented or bandpass enclosures.
Pmax: 100W RMS, **Fo:** 25Hz
Sensitivity (1W/1m): 92dB
Qts: 0.342, **Vas:** 207.8L
C 3100 Normally $99,

NOW JUST **$65**

YOU WANT BASS? Try this 12" beast for size!

CD Carry Wallet

Made from heavy duty fabric with internal padding, this Compact Disc carry case will keep up to 20 of your CDs organised and dust-free. Each CD has a separate protective sleeve, and the case is a fraction of the size of 20 hard cover CDs!

Keeps up to 20 CDs protected and clean in a compact, easy to carry package! Great for cars!

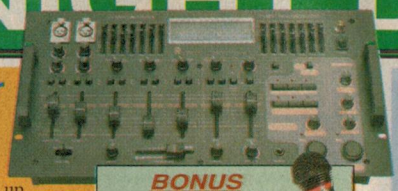
A 9250 $14.95,

NOW **$9.95**

1-800 999 007 **PERTH (08) 9328 1599**

OVERNIGHT DELIVERY

12 Input Stereo Mixer
with DIGITAL SAMPLER



The Rolls Royce of our mixers, the A 2560 has everything that opens and shuts, and is an incredibly versatile DJ mixer! Features 6 channels with 12 inputs, up to 3 Mics, 6 line and 3 phono inputs. Assignable cross-fader and headphone monitor. Variable echo and repeat effects. Balanced mic inputs and separate 7 band EQs for left and right channels. Digital sampler can accommodate 3 samples of 3 secs each, or one 10 sec sample. 3 stereo outputs with switchable level (1.5V or 775mV).

A 2560 Normally $649, NOW ONLY **$549**

BONUS MICROPHONE!
Purchase an A 2550 or A 2560 Stereo Mixer, and we'll throw in a **C 0366 Dynamic Mic**, valued at $24.95, ***FREE!***

9 Input Stereo Mixer

An ideal DJ mixer, the A 2550 has 5 channels with 9 inputs, with up to 4 mic, 3 line and 2 phono inputs. Cross-fader between phonos and assignable headphone monitor. Balanced mic input, 3 band EQ and twin VU meters.

A 2550 Was $249, NOW **$199**

Great for DJs, video dubbing, PA systems etc. Features phono crossfader, headphone cue monitor and stereo VU meters.

Piezo Siren *SELLOUT!*

Two models available, ideal for use with home security systems as an indoor siren. Try being in the same room as one of these beasts in full song! Piercing two-tone warble at up to 102dB@1m.

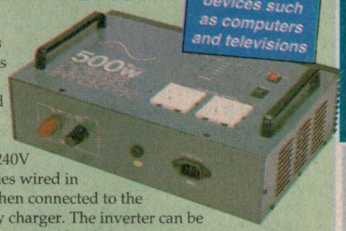
A fantastic bargain at over 50% OFF!

S 6135 6-15VDC Siren Was $19.95, Now **$9**

S 6140 12V DC Siren Was $19.95, Now **$9**

SAVE OVER 50%!

24V / 240V 500W Sinewave Inverter
with Battery Charger



Ideal for sensitive devices such as computers and televisions

Sinewave inverters are ideal for powering equipment which is sensitive to the waveform of its mains supply. Devices such as some televisions, data logging equipment, monitoring stations, computers, digital clocks and more can all be affected by variations in mains frequency, waveform and voltage. Sinewave inverters will run fluorescent lights where many square wave inverters won't. This inverter provides 500W of 240V sinewave power from a 24V DC supply. i.e. 2 x 12V car batteries wired in series. It also has a battery charger to maintain the batteries when connected to the mains, and can be used in two modes, inverter only, or battery charger. The inverter can be configured to start up automatically when mains power to its input socket fails.

M 8100 Normally $739, **October SUPER SPECIAL** **$599**

Mini Drill Set

A fantastic addition to any hobbyist tool kit, this powerful mini drill comes with a plugpack adaptor, four grinding stone bits, a cutting disc, four chucks (0.5, 1, 1.5, 2.4 and 3mm) and 5 PCB drills (0.5, 0.8, 1, 1.2 and 1.5mm). Features rocker switch activation and easy release chuck mechanism. Great for drilling and trimming PCBs, engraving your valuables, model making, polishing gems or jewellery, custom instrument panel work etc.

T 2300 Normally $59, NOW **$49**

Includes 4 chucks, 5 drills, 4 grindstones, a cutting disc and even the plugpack!

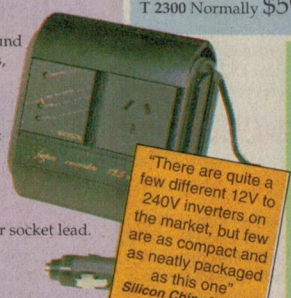
1500W Switchmode 12V / 240V Inverter

Modified sinewave circuitry! Can power flouro lights & microwaves!

This inverter provides up to a massive ***1500W*** of 240V power from a heavy duty 12VDC car or truck battery. Switchmode circuitry eliminates bulky and heavy output transformers, making this unit very lightweight compared to similar inverters. It's suitable for a wide range of applications such as remote homes, sail & power boats, building or mine sites, off road vehicles, caravans, farms etc. **Features:** • Over temperature & overload shutdown • **Auto fan cooling** • Low battery warning & shutdown • **Heavy duty leads** • Twin outlets • Weighs only 3.6kgs

M 8140 Normally $995, NOW **$795**

125W Mini Inverter



This amazing inverter provides up to 125W of 240V AC power from your car cigarette lighter socket! During our testing, it ran our entire A/V room setup, including a huge 68cm television and surround sound amp! Can power televisions, VCR's, lights, small battery chargers, shavers and hi-fi systems. Features low battery indicator, thermal & overload shutdown and is totally silent when operating. Built-in 3-pin plug (no adaptor required). Includes car cigarette lighter socket lead.

M 8105 Normally $129, NOW **$99**

"There are quite a few different 12V to 240V inverters on the market, but few are as compact and as neatly packaged as this one" ***Silicon Chip, April '97***

Extra Heavy Duty Hookup
SCOOP PURCHASE!

High temperature rated hookup (105°C). ***32/0.20*** rated at ***10A***.
100m Rolls.
WW2280 Brown
WW2282 Blue
WW2285 Green

Normally .55¢ a metre,
NOW **$25** 100m Roll
OR Buy One Roll of Each Colour for ONLY **$60**

Digital Multimeter
With Capacitance, Transistor Hfe and Temperature Ranges.

FREE PROTECTIVE HOLSTER!

This multimeter features a large 3.5 digit LCD display, and has a suite of useful features. Ranges include Capacitance up to 2000µF, Resistance to 200MΩ, Transistor gain, DC Volts and Amps, AC Volts and Amps, and even a Temperature range with the 'K' type thermocouple. It also has a 15 minute auto power off to prevent flattening the battery when you forget to turn it off! Measures DC resistance to 200MΩ and DC current to a huge 20A.

Includes test leads and K-type thermocouple!

Q 1060 **$89**

FREE SUPER BONUS!
Buy a Q 1060 DMM and receive a Q 1087 protective holster, valued at $12.50 ***FREE!***

Professional 5 Sector Digital Alarm System
with Auto Dialler

Improve the security of your home or business with this microprocessor controlled alarm system, and get $100 worth of accessories FREE!!

This system is the same type as used by many commercial alarm companies to protect both residential and business premises across Australia.

Incorporating an inbuilt ***Austel approved*** auto-dialler, this alarm can be configured to automatically dial two preset numbers in the event of an alarm, i.e. it could ring a neighbour or alarm monitoring company. The main controller circuitry is housed in a sturdy steel cabinet, which can house an optional back up battery if required. The keypad control unit is generally located at the front door for easy access to arming and disarming of the system. The entire system is controlled and programmed via this keypad. A combination of normally open and normally closed sensors can be used on any zone. **Features:** • master code and three adjustable user codes • monitor function which tests battery backup and mains failure • four sectors with programmable attributes plus 24Hr zone • extensive noise protection circuitry and end of line resistors for added security • once triggered the alarm has the option of a silent alarm plus dialout • quick arming option • zone bypassing for sectors which are false triggering • bell test - to test the external sirens without dialling out • door chime mode for entry/exit paths • battery backup • home or away operation • accessible alarm memory for confirming which sectors were triggered • separate instruction and installation manuals • 12 months warranty

S 5490 **$279**

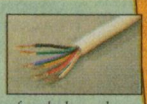
Pulse Count PIR Detector

Buy a set of 4 & SAVE!

Incorporates a pulse count circuit to minimise false triggering, "sense" LED, tamper switch and relay output. Range up to 12m horizontal when mounted 2m from the floor, with a 90° detection angle. Coverage can be changed by sliding the PCB up or down in the case. Can be configured as Normally Open or Normally Closed with . Suits the S 5490 alarm or many other security systems.

S 5315 Was $49, NOW **$39**, or Buy 4 for **$140**

6 Core Security Cable



W 2356 **$1.30** per metre
or **$170** 200m Roll

NB: 200m is enough to wire an average four bedroom home

Siren Cover

S 5460 **$28.95** ea

Super Bonus Deal!

Purchase a S 5490 5 Sector Alarm system before October 31st, and we'll supply ***$100*** worth of accessories ***FREE!!!***

Bonus package includes M 9127 Plugpack, S 5075 Backup battery, S 6130 Siren, S 5445 Blue Strobe, 2 Large alarm stickers and 4 window stickers!

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ALTRONICS COMPONENTS

Fax Order Line (08) 9328 3487

Universal Regulator Kit

(See EA Aug '97) A flexible circuit that provides preset voltage output of 3, 5, 6, 9 or 12V DC. Suitable for powering a wide range of DC low power circuits, such as running a personal CD/radio from a car cigarette lighter or powering external peripherals from a PC. Designed with the experimental hobbyist in mind the regulator can be changed with the moving of a jumper shunt connector, it's that simple. Can deliver up to 1.5 A depending on heatsinking.

Super Versatile circuit! Simply changing the pin header selects the output voltage. Up to 1.5A capacity!

K 3220 **$6.50** NEW!

500W Amplifier Module Kit

NEW!

MASSIVE 500W! Great for DJ amps, component subwoofers, instrument amplifiers, even PA systems!

(See SC Aug '97) ***What a Beast! 500W into 4 ohms!*** Just the thing to power dedicated subwoofers, DJ, PA or party amplifiers or the like. Silicon Chip claims It is the biggest amplifier ever published in a magazine and they would be right. ***Features*** • 500W RMS into 4 ohms , 278W into 8 ohms (-0.3dB @ 20hz and 20KHz) • Input sensitivity 1.43V (at full power into 8 ohms) • Distortion typical less than 0.01% • Signal to noise 117db un-weighted 122db A-weighted • Supplied with the PCB and the components to populate the board, ***requires a heatsink and power supply (±80V DC)***

K 5190 **$215**

5 Digit Tacho Kit NEW!

At last! A useful digital tacho with super-fast update time and 1 rpm resolution!

(See EA Oct '97) A fantastic, high-tech addition to your car's dashboard. This 5 digit tachometer features a crystal timebase for super-accurate readings, a 0.25 second update time and a resolution of ONE rpm. It also has a dimmable display, leading zero blanking, last digit "0" lock (stops "rolling" display), and can read to 60,000rpm if required. Not even rotaries rev *that* high! Can be configured for ignition coil input (3V) or low level input (1V) from an existing tacho. If you're after a *useable* digital tacho for street or circuit applications, this is it! ***Note: Case NOT included.***

K 4325 **$79**

Multi-Spark Capacitor Discharge Ignition Kit

NEW!

Provides multiple sparks for a cleaner, extended mixture burn, increasing power and efficiency!

(See SC Sept '97) Why multi-spark? Fuel burns more thoroughly with a multiple spark and can therefore improve engine performance especially in two stroke motors, older engines and high performance four strokes. The circuit also fires fouled plugs, thereby reducing the time between plug replacement. If you own a go-kart, why not boost it's performance with this circuit? • Operates on reluctor, points or hall effect signals • Regulated 300V output (constant spark energy) • Twin inputs for twin coil systems • Output for electronic tachometers • Usable to beyond 1000 sparks/second (equals 15000 rpm for V8) • Includes all parts except the pickup circuit. • Supplied in an attractive black powder coated metal- automotive project box

K 4370 **$110**

PC Stepper Motor Controller

Start experimenting with robotics! Allows accurate control over a stepper motor.

(See SC, Sept '97) This kit allows control over a single stepper motor via the parallel port of a PC computer. Uses include control of robot projects or any other application where a precise number of turns or revolutions is required (with a little imagination and experimentation maybe a turns winder for transformers). Daisy chained together, control of up to eight motors is possible with one PC. Supplied in short form and requiring a 12V DC power supply this project comes with all the components and PCB to begin experimentation.

K 2835 **$32.50** NEW!

Remote Control Volume Kit

Build it into an existing amp and control your stereo volume from the comfort of your armchair!

(See EA July '96) This kit uses an infra-red transmitter and receiver and a motor driven pot to enable you to control the volume of your amp or preamp from anywhere within 5m line-of-sight of the receiver. Build it into your home-built amplifier or preamp for a professional finish. Includes remote transmitter case.

K 5024 **$45**

Laser Transceiver Kit

NEW!

(See EA, Aug '97) Utilising a MAX232 IC and a clever little circuit to strobe the laser and interpret the received signal, this kit allows two computers to communicate over distances of up to 50m or more (depending on the laser used) via their RS232 ports. Supplied shortform with the components to build the transceiver. Laser pointer extra, see our A 0201, this month only $59.

K 2860 **$21.95**

Laser Transmitter Kit

(See EA, Aug '97) The transmitter can be used for light effects, one way (half duplex) communication with the PC and experimentation. With RS232 input and TTL input capability. Supplied shortform with components to build the transmitter only.

K 2862 **$15.95**

A 0201 Laser Pointer **$59**

Mini-Strobe Kit

NEW!

(See EA, Aug '97) Taking advantage of a new range of white LED's this mini strobe can be used to measure the RPM of any thing that rotates or moves. From 400 - 4000 RPM , the strobe rate can be increased until the object motion appears to stop, then the RPM can be read off the scale on the front panel. Supplied with a project box with silk screened front panel, the kit has provision on the PCB to expand with the addition of more LED's, variable pulse width and an addition to allow the measurement of pulse width on a frequency counter. Requires 9V battery (not included).

K 5785 **$21.50**

ALTRONICS

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Standard Delivery & Packing Charge: $4.00 to 500gms, $5.50 500gms-1 kg, $8.00 1kg-5kg. Where possible we process your order the day received and despatch via Australia Post. Allow approx 9 days from day you post order to when you receive goods.

Overnight Jetservice: Up to 3kg is $9.50, 3kg to 5kg is $16.00—We will process your order the day received (if placed before 2.00PM WST) and despatched for delivery the next day. Country areas please allow an additional 24-48 hours.

Heavy Service: All orders of 10kgs or more must travel Express Road—Please allow up to 7 days for delivery. $12.00 to 10kgs, $15.00 over 10kgs. **Insurance:** As with virtually every other Australian supplier, we send goods at consignee's risk. Should you require insurance cover against loss or damage please add $1.00 per $100 of order value (minimum charge $1). When phone ordering please request "Insurance". **Altronics Resellers:** Chances are there is an Altronics Reseller right near you—check this list or phone us for details of the nearest dealer. Blue Ribbon Dealers are highlighted with a ●. These dealers generally carry a comprehensive range of Altronic products and kits or will order any required item for you.

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Doc.GL694

Mini project:

A 'NO FRILLS' ACTIVE ANTENNA

In this article the author describes a no-frills version of the Active Antenna we published in December 1995. This version was designed purely for use on the popular 49 to 13 metre shortwave bands, and does away with a lot of the circuitry that isn't needed for this application. The result is a cheap, low cost active antenna that gives good performance using only a short whip antenna.

by WILHELM HIRSCH

If you don't have room for a decent shortwave antenna, because you live in a apartment or home unit, for example — or it just isn't practical to start stringing up bits of wire in your back garden, then you probably need an active antenna. Back in December 1995, Jim Rowe described an active antenna that covered the high frequency bands from 500kHz to over 30MHz. This wide range was achieved by switching various coils in and out of circuit, and from all accounts it worked very well.

For my own use, I only needed to cover the 49 to 13 metre bands, so I set about stripping down the original design to make a smaller, cheaper and more specialised version.

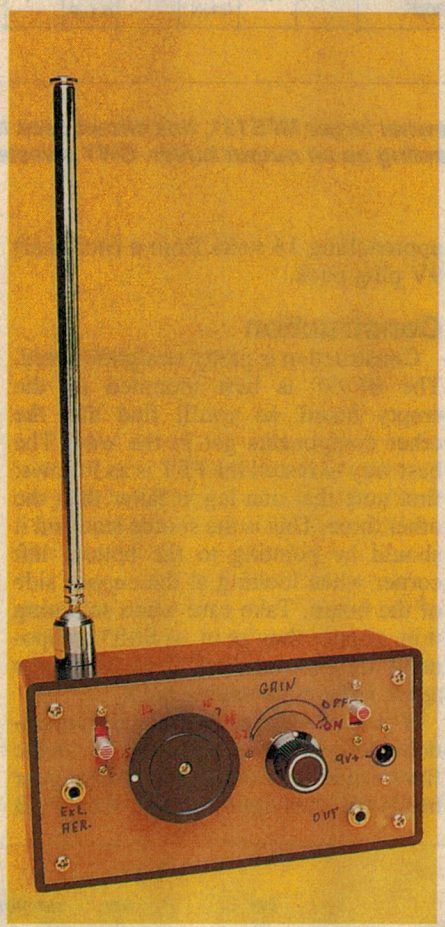
I initially built this active antenna using scrap parts, and housed it in a case made from odd bits of Perspex. This design has been doing sterling service with my Sangean 803A, on my workbench.

While its performance was a credit to the original idea, my original prototype wasn't up to presenting in the magazine, so I set out to build something looking a little more respectable. I started by taking my parts list to the local Dick Smith agency, which in turn had to send away to head office for some of the more exotic components.

Of course my order clashed with Dick Smith's stocktaking, so some extra delay was assured. Such are the benefits of living out in the sticks!

Startled look

I filled in time making my PC boards, after getting an assurance over the phone that the MFE131 dual-gate MOSFETs were still available, as these are supplied in the usual TO-92 package. I really didn't cherish the idea of handling the new SMD equivalent BF998, which was the type used in the 1995 design.



Designed for use in the shortwave bands, this trimmed-down version of the active antenna uses few parts and gets good results. It is shown here with its whip antenna partly extended, but an external antenna can be used instead.

When my ordered parts arrived, I got a startled look from the salesman, with the question: "Is this really what you ordered?". He showed me a tiny plastic package, containing some even tinier parts. That's right, the MFE131 was no longer available and so Dick Smiths had supplied BF998s instead.

My boards had been laid out for MFE131s, and I was worried that I would have to re-design them to suit the SMD version of the FET.

Fortunately the orientation of the terminals was the same in both packages and so my work was not entirely for nothing. With a little bit of ingenuity I managed to mount the SMD device *on top* of the PCB by connecting it to the board with single strands of wire pulled from a piece of stranded hookup wire. The circuit suffered no ill effects from this unconventional mounting, even if the tiny component looks a little odd where it is.

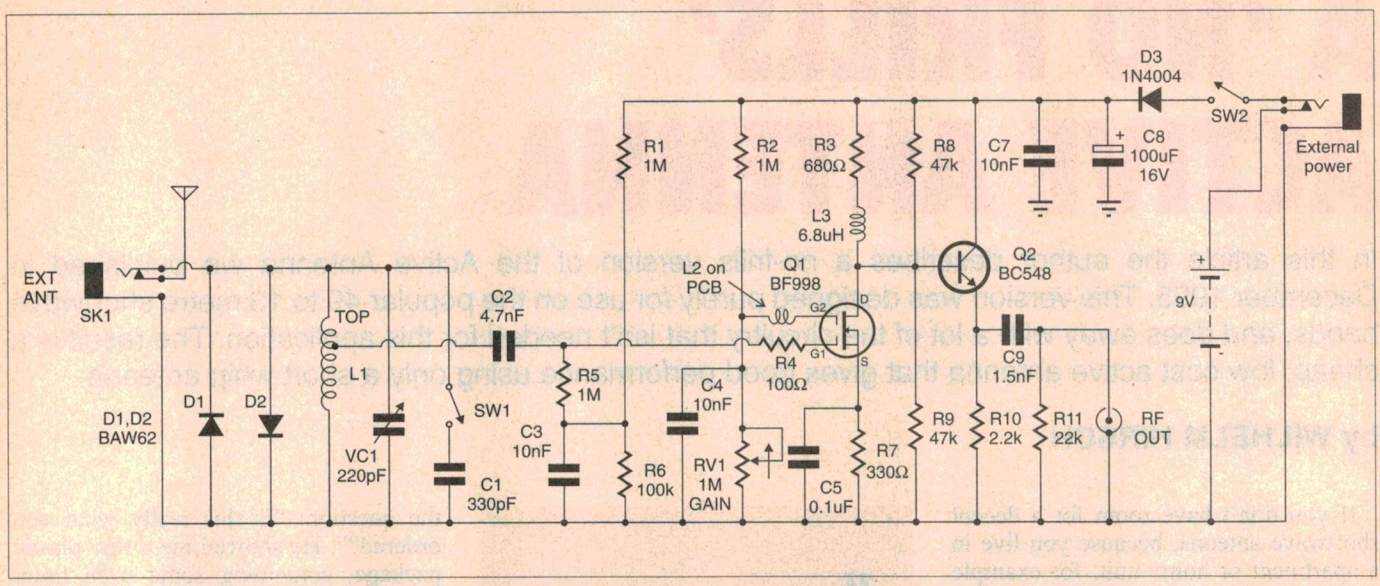
I have asked if the artwork for the PCB could be modified to accommodate the SMD component, so with any luck the board pattern shown in this article will be updated to suit.

All up, this little unit cost me only $30.00 to build, and I have had a lot of fun building it and trying it out.

The design

When I first started this project I decided that I didn't need 'DC to daylight', as I was only interested in the 49 to 13 metre bands. This eliminated some of the coils and switching and also reduced the cost and complexity.

In the original 1995 design, varicap tuning was used and this required a regulated power supply to keep the tuning stable. In my version, I used a small plastic tuning capacitor and did away with both the diode and the regulator with satisfactory results.



Although originally designed for the somewhat larger MFE131, this circuit uses the surface mount BF998 dual-gate MOSFET as the wide band amplifier, with Q2 acting as an output buffer. SW1 selects the tuning band, while VR1 adjusts the gain at the frequency selected by VC1.

The decision to use the plastic tuning capacitor was backed by the knowledge that some of my smaller receivers from Sony and Grundig are tuned by just such capacitors and don't tune that badly at all.

Switch SW1 allows the 330pF capacitor to be switched in across the coil and VC1, to give a second tuning band simply and at very low cost.

As an afterthought I would have liked to incorporate a 'through' switch, shorting the antenna through to the output, enabling me to use the receiver for FM reception with the amplifier switched off. This would be very easy to implement and would add to the use of the system.

This unit does very well on a variety of voltages, ranging from a run-down nine volt battery to something approaching 14 volts from a (nominal) 9V plug pack.

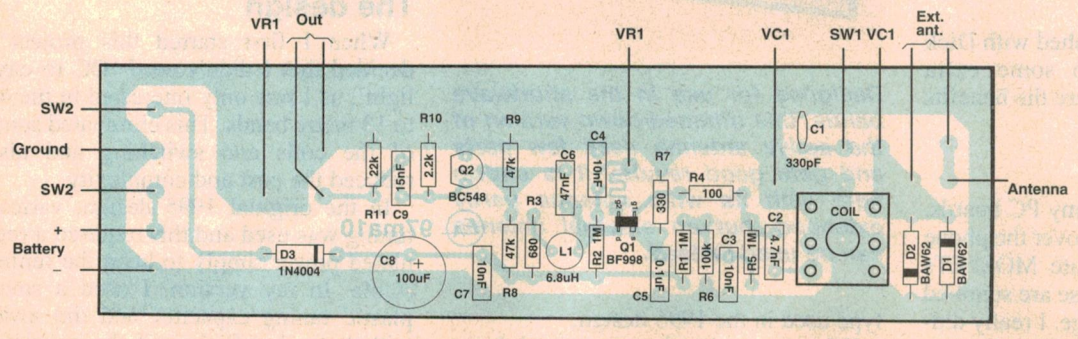
Construction

Construction is pretty straightforward. The BF998 is best mounted on the empty board, as you'll find that the other components get in the way. The best way to install the FET is as follows: first note that one leg is fatter than the other three. This is the source lead and it should be pointing to the bottom left corner when looking at the *copper* side of the board. Take care when soldering it in, as once they're in, as SMD components are notoriously difficult to remove again without damaging them.

If you've never soldered SMD components before, you're best starting with the finest soldering iron tip you can get your hands on. Then *lightly* tin one of the PCB pads, leaving the other three bare. Now, using a small probe (a toothpick works well), position the device as shown in the overlay and hold it in place. You can then apply the soldering iron to the tinned pad, and the FET's pin should sink through the solder and sit flat on the board. Remove the iron, and leave the component to cool down for a few seconds.

With any luck, the other three pins will still be aligned with their pads and you can solder them in — quickly, but carefully! If the FET moved while you were making the first joint, carefully reheat the joint and nudge the FET into place with the probe.

In the prototype I stuck the component to the board with craft glue, then ran single strands of tinned copper wire (pulled from stranded hookup wire) from each pin to the appropriate hole.



This overlay diagram shows the MOSFET mounted on the solder side of the board, with its source (the fat pin) connected to R7 and C5. L2 in the MOSFET's G2 lead is part of the trackwork on the board, while L1 is wound on a 5mm slug tuned former.

Not an easy task, when I had the other components already installed and a soldering iron tip 2.5 millimetres wide!

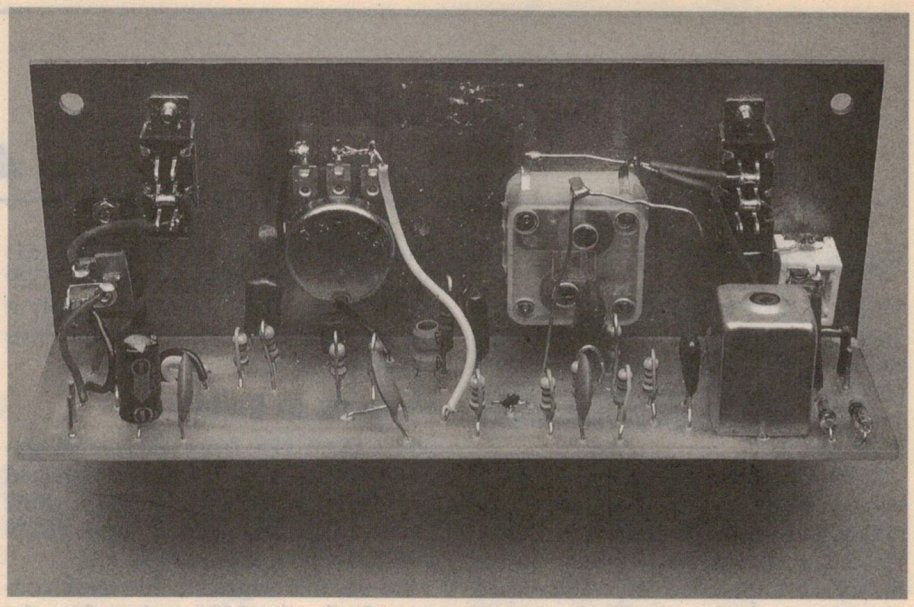
The coil L1 is wound on a standard 6-pin miniature former with shielding can as used in the 1995 project. The only difference is that I used 18 turns with the tap taken off at eight turns from the top. This gave me the desired tuning range, after I set the trimmers on the back of the tuning capacitor to minimum. The rest of the components can be installed in any order and there's nothing particularly critical about their installation — just use the overlay diagram to see where everything goes.

For a case, I used a Zippy box with a front panel made from blank PC board, and the main PCB fillet soldered onto the back of it. This provided a degree of shielding to the circuit, and solved the PCB mounting problem into the bargain. You can use the photo as a guide to drilling the holes in the lid, but with a bit of re-orientation of the tuning capacitor and the gain control it would be possible to use a standard size pot instead of the mini version I used.

The whip antenna I used came courtesy of an old portable B&W television and was far more robust than anything I could find in the stores. Although slighty thinner, any of the ones available from the from the stores should do. You'll want something that extends to around around 600mm long, and it can then be mounted on the top left hand side of the case.

Performance

The performance of the little unit, while not earthshaking, is quite pleasing. Connected to my Sony ICF 2001D I get the same S-meter reading as with about five metres of wire strung outside, and that's quite something if you're in a location where stringing even a simple antenna is out of the question. This is far better performance than I got from my earlier efforts, and even from a commercial unit I had recently tried.



In the author's prototype you can just see the surface mount MOSFET Q1 soldered on the top side of the board in this shot, as well as the inter-wiring between the components mounted on the lid.

PARTS LIST

Resistors

R1,2,5	1M
R3	680 ohms
R4	100 ohms
R6	100k
R7	330 ohms
R8,9	47k
R10	2.2k
R11	22k
VR1	1M potentiometer

Capacitors

C1	330pF disk ceramic
C2	4.7nF MKT or polyester
C3,4,7	10nF MKT or polyester
C5	0.1uF MKT or polyester
C6	47nF MKT or polyester
C8	100uF 16VW electrolytic
C9	15nF MKT or polyester
VC1	60 - 160pF tuning capacitor

Semiconductors

Q1	BF998 dual gate MOSFET
Q2	BC548 or equivalent NPN transistor
D1,2	BAW62 or similar
D3	1N4004 power diode

Miscellaneous

PCB coded 97ma10 and measuring 125 x 35mm; plastic case 68 x 131 x 40mm; 2 x SPDT toggle switches; 6.8uH choke; 5mm miniature coil former with 6-pin base, tuning slug and shielding can; 2 x 3.5mm phono sockets; 2.1mm DC panel mount socket; 600mm telescopic rod antenna; knobs, battery snap, hookup wire etc.

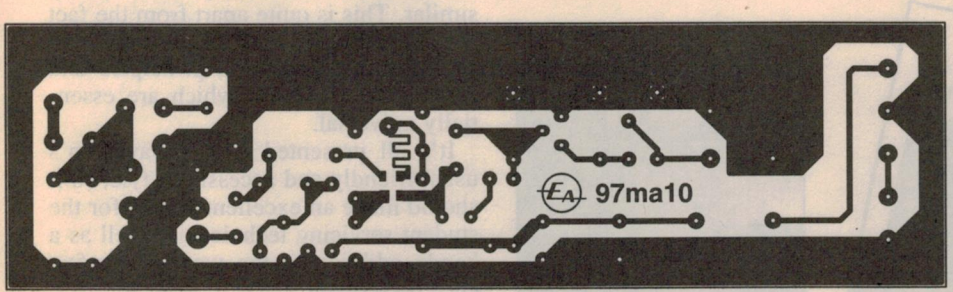
Having chased Shortwave Reception for something like 40 years now I don't expect miracles any more, not even from the best of receivers.

One nice aspect of this amplifier is that it introduces a tuned circuit into the input of a lower priced PLL receiver, for improved selectivity and image rejection.

Only recently have firms like Grundig and Sony introduced automatically tuned input circuits into their receivers, and then only into the more costly ones. None of my PLL-synthesized receivers has a tuned input, a fact I've cursed sometimes when I found myself sitting under the shadow of an ABC transmitter in the suburbs of Melbourne or Brisbane, or alongside an amateur whose transmission blanketed everything I wanted to receive.

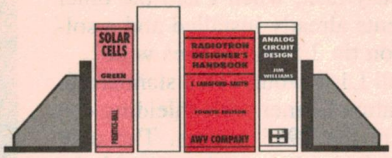
Even far-away transmitters like Quito (Equador) have filled an entire shortwave band with hash, disabling an expensive PLL receiver, while a little Sony ICF 4900, hardly larger than a couple of packs of cigarettes, is quite capable of sorting out the mess.

The possibility of blanking out an out-of-band transmitter, like that neighbourhood CBer, makes this little active antenna a worthwhile addition to almost any radio setup. ❖



The artwork shown below has been re-designed to accommodate the SMD MOSFET, and is reproduced here full size.

NEW BOOKS



Valve amplifiers

VALVE AMPLIFIERS, by Morgan Jones. Published by Newnes (Butterworth-Heinemann), 1995 (Reprinted 1996). Soft covers, 234 x 154, 374 pages. ISBN 0-7506-2337-3. RRP $62.95.

With so much renewed interest in valve audio amplifiers for domestic listening, this book should be quite popular. It's a comprehensive guide to the theory and practice of valve-based amplifiers and preamps, for those coming to this field without much background. As the author points out, most other books on the subject are over 25 years old and also out of print.

Formerly a design engineer with the BBC, Mr Jones has produced an essentially down-to-earth book which seems to give a very good grounding in the theory of operation, design, construction and troubleshooting of valve amplifiers. Although it's written from a modern viewpoint, the approach is also quite objective and without the 'rose-tinted spectacles' of nostalgia — so the reader is helped to put many of the concepts into a realistic perspective.

There's plenty of basic design theory, and enough maths to satisfy the reader who really wants to 'get stuck in' and design their own. Mr Jones has even included program listings, to help in various design areas. And on the more practical side, there's guidance on tools, metalworking and troubleshooting.

In short, it's a very well written reference on valve amp and preamp technology, for the modern reader.

The review copy came from Resurrection Radio, of 242 Chapel Street (PO Box 2029), Prahran 3181; phone (03) 9510 4486, or fax (03) 9529 5639. Resurrection Radio can supply it for the price shown, plus postage where applicable. (J.R.)

Projects to build

306 CIRCUITS from Elector magazine. Asia-Pacific Edition, published by Tech Publications, 1997. Soft cover, 155 x 225mm, 388 pages. ISBN 981-214-699-7. RRP $24.95.

As the title suggests, this book contains the details of 306 projects from the well known European electronics magazine *Elektor*. It is the seventh in the '300 series' of Elektor circuit design books. If you have the other six, adding this one to your collection will give you access to over 2000 circuit ideas and projects.

Like the previous books, this one has project and circuits that cover a wide range of electronics. It's arranged in five parts: audio and hifi; computers and microprocessors; general interest; power supplies and battery chargers; radio, television and communications; and test equipment. The designs in each part are presented in alphabetical order. Many of the designs include a PCB layout, included in an appendix. Of course it's up to you to convert the layout to a photographic negative (or whatever method you use) to make a board.

Each circuit design includes a brief description, a circuit diagram and parts list. Some use parts that are not readily available in Australia, while in some cases there's an equivalent *EA* project, such as the MIDI for PC sound card (we called it a MIDI breakout box). But in general, there's a wealth of useful circuits.

The computer section has such things as a linefeed add-on for a HP Deskjet 520, a joystick to mouse adaptor for PCs and an input/output interface for Centronics ports.

The general interest section has by far the greatest number of circuits, and even includes a few ideas such as how to desolder a surface mount IC. There's also things like a 12V stroboscope and an auto-start for older fax machines.

The review copy came from Jaycar Electronics, and the book is available from your nearest Jaycar store, catalog number BM2476. (P.P.)

TV servicing

TROUBLESHOOTING & REPAIRING SOLID STATE TV'S, by Homer L. Davidson. Third edition, published by Tab Books (McGraw-Hill), 1996. Soft covers, 235 x 190mm, 620 pages. ISBN 0-07-015754-5. RRP $49.95 (NZ$64.95 incl GST).

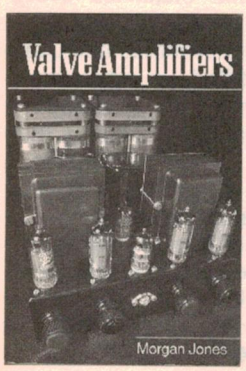
The third edition of this popular servicing reference book by prolific US technical author Homer Davidson, who ran his own successful servicing business for 38 years before 'retiring' to write full-time...

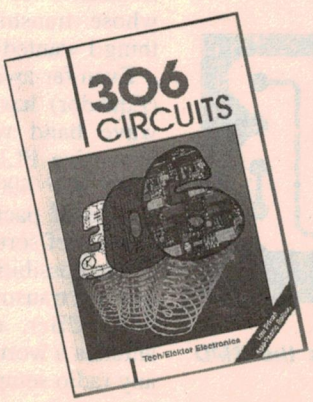
As with his other books on servicing, this one takes a very practical approach, with plenty of emphasis on sensible and efficient servicing techniques — not just circuit theory. There are quite a few photos, and lots of circuit snippets showing exactly where to check for symptoms of particular types of fault.

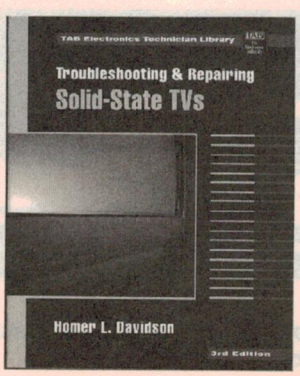
Although the models discussed and used for the examples are all taken from the US market, there's still a great deal of value for the reader in Australia or New Zealand. Most of the models in all of these markets are manufactured in Asia, and as a result they can be pretty similar. This is quite apart from the fact that a fair proportion of the book's content deals with general principles and servicing techniques, which are essentially universal.

It's all presented in Mr Davidson's usual friendly and accessible style, so it should make an excellent choice for the student servicing technican as well as a handy addition to the workshop reference bookshelf.

The review copy came from McGraw-Hill Australia, of PO Box 239, Roseville 2069. (J.R.) ❖







CEBus the ticket for home automation

Mains wiring is just one medium defined in the CEBus open communication standard for consumer electronics. Find out how a telephone talks talks to a television, in this overview of the home automation network that's as close as your nearest power-point.

by ANDREW MARCH

The Consumer Electronics Bus or 'CEBus' offers a standard way for consumer electronic products from different manufacturers to talk to each other over a residential network.

The goal of CEBus (pronounced 'see-bus') is to allow 'plug and play' operation, between devices from any manufacturers whose designs comply with the IS-60/EIA-600 CEBus standard developed by the US Electronic Industries Association.

Devices connected to a CEBus network interact by sending commands to change the state of other devices (e.g., picking up the telephone handset mutes TV sound), or by sharing information (e.g., inside temperature from a single sensor is read by the air-conditioner thermostat as well as the TV set for on-screen display).

The key features of CEBus which allow interoperability are:
(1) defined electrical characteristics for signalling over five media types (power line, twisted pair, coax, RF and infrared);
(2) modelling of consumer products as generic data structures called contexts; and
(3) a dedicated language, called CAL, for inspecting and changing this data.

Network Model

Subdivision of communications tasks within CEBus roughly follows the International Standards Organization (ISO) open model. Fig.1 shows the protocol stacks for two communicating CEBus devices. Each layer of the stack provides a well defined set of services to the one above. Conceptually, a layer communicates only with its peer layer in another device.

The Application Layer connects the user application that operates the product to the network. This layer can generate its own messages via the CAL interpreter, detecting changes to the context data structures, or it can accept fully formed messages from the user application and pass them down the stack via the Message Transport Sub-layer. More on CAL later...

The Message Transport Sub-layer provides message delivery services to the Application Layer, including end-to-end acknowledge of message delivery. It may also provide encryption and message authentication (to verify the identity of the sender) for messages that require security.

The Network Layer handles routing of messages between media (a message can jump from one medium to another order to reach its destination, or can be explicitly confined to certain media types such as power line only).

This layer may also provide a segmented service, where long messages are split into short packets for transmission and reassembled on reception. This is necessary because the following Data Link Layer has a limited maximum message size.

The Data Link Layer attaches source and destination addresses to the message for transmission and checks addresses on reception. It executes the channel access protocol for access to the shared medium, plus checksum error checking for coax, infrared and twisted pair. This layer can also provide immediate acknowledgement of packet delivery.

Finally, the Physical Layer provides CRC error checking for power line and RF, symbol timing and encoding, superior/inferior state generation and medi-

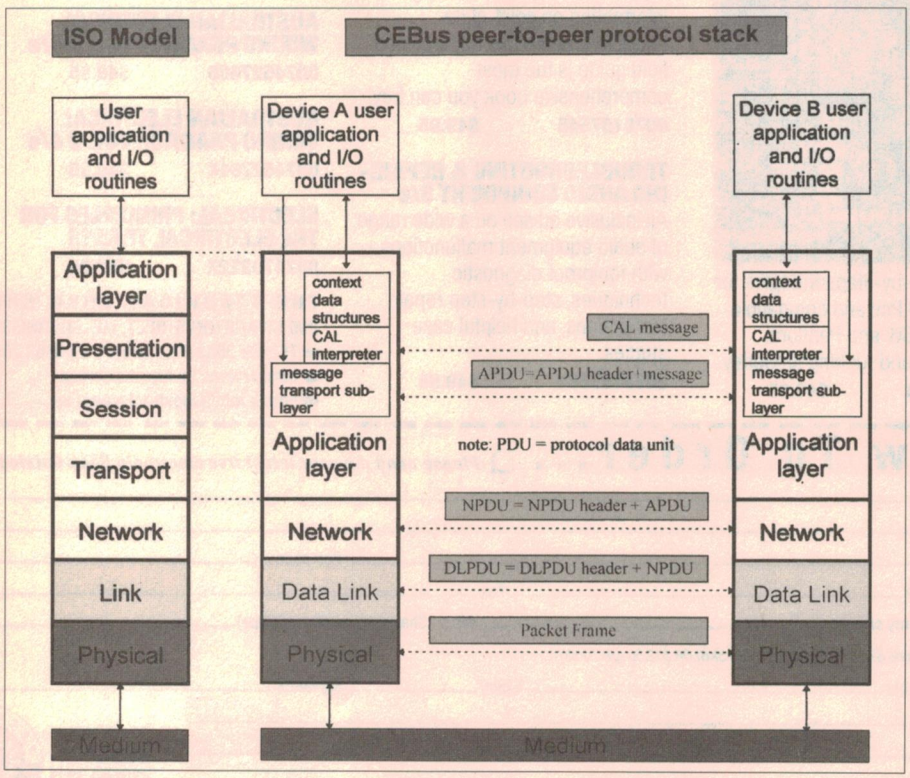


Fig.1: The CEBus protocol stack, illustrating peer-to-peer communications between layers. Messages sink down one stack, pass across the medium and bubble up the other stack.

um interface. Fig.2 shows a fully formed packet frame as passed across the medium between the physical layers.

Contexts & Objects

CEBus achieves interoperability by modelling products in terms of published descriptions known as contexts. Products interact solely through each other's contexts, which allows uniform access to product functions regardless of manufacturer.

Context definitions and numbering are published by the CEBus Industry Council. While it is possible to define custom contexts, manufactures are encouraged to stick to published contexts otherwise the benefits of interoperability may be lost.

A context defines a functional block within a product. There may be more than one context in a product. A CEBus TV, say, might contain an Audio context, a Tuner context and Clock context. Every product must also contain the compulsory Universal context, which holds such items as the device address and serial number.

Contexts are tree structures that contain other structures called Objects — which in turn contain Instance Variables (IV's). The IV's contain actual values that affect the state of the product.

For example, the Audio context includes a Source Switch object (an instance of a generic multi-position switch object), a Volume Control object (an instance of a generic analog control object) and a Mute Setting object (an instance of a generic binary switch object) plus other objects.

The Mute Setting object contains a number of Instance Variables including **current_position**, **default_position**, **previous_position**, **reporting_condition**, **report_header** and **report_address**. The switch setting is simply the value of the **current_position** IV.

IV's can be of type boolean (true/false), numeric (integer or floating point), character string (ASCII characters from hex 00 to hex 7F) or data (array of bytes). Numbers are transmitted as strings of ASCII characters, so that 1.25 is sent as hex **31 2E 32 35**. IV's may also take on the attributes of read-only and non-volatile.

In general, CEBus objects in one device are paired with complimentary objects in one or more other devices. This association is known as object binding. For example, a binary sensor object that models an on-off sensing function typically sends messages over the network to set the **current_position** of a binary switch actuator object to either a boolean 0 or 1.

CAL Methods

The CEBus Common Application Language or 'CAL' defines the syntax of messages that pass between devices. CAL is used to inspect or change the values of IV's in objects by means of pre-defined actions called methods. The general form of a CAL message is:

<context ID><object number><method><IV><value>

Let's compose a CAL message to turn on a binary switch. This message could come from a yet-to-be invented CEBus telephone, that sends messages to silence noisy TV's and stereos when the handset is lifted.

The message goes to the mute control for an audio amplifier (context 10, object 9). We'll use the setValue method (value 45) to set the binary switch **current_position** IV (denoted by ASCII 'C', or hex 43) to boolean 01 (on). The complete CAL mes-

Table of CAL Methods

Hex	Name	Description	Types
40	nop	no operation	
41	setOFF	set boolean IV off	B
42	setON	set boolean IV on	B
43	getValue	get IV value	B,N,C
44	getArray	get data IV value	D
45	setValue	set IV value	B,N,C
46	setArray	set data IV value	D
47	add	add IV values	N
48	increment	add immediate to IV value	N
49	subtract	subtract IV value	N
4A	decrement	subtract immediate from IV	N
4B	compare	compare IV values	B,N,C,D
4E	swap	swap IV values	B,N,C,D
4F	report	invoke a report	B,N,C,D
52	exit	end current level of execution	
53	alias	alias a string with an ID	
54	inherit	assign resource to object	D
55	disinherit	release object from resource	D
56	if	conditional message execution	
57	do	do / while loop primitive	
58	while	while / do loop primitive	
59	repeat	message repeat	
5A	build	create macro	
5B	copyValue	copy IV or immediate	B,N,C,D

Key: B=boolean, N=numeric, C=character, D=data

Fig.3: CAL methods. Conditional execution, looping and macros are defined in the CEBus Common Applications Language.

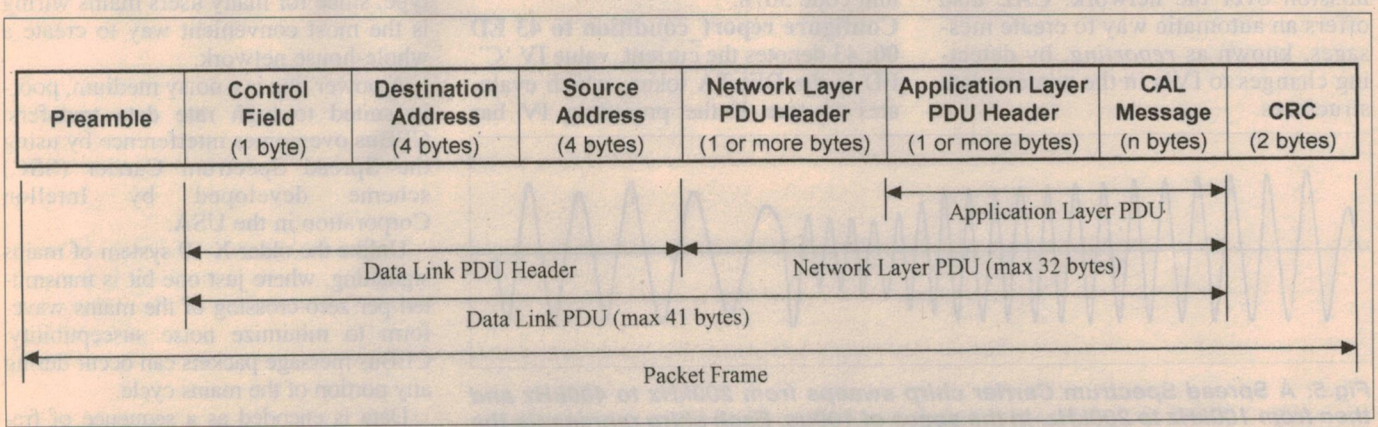


Fig.2: A complete CEBus packet frame, showing nesting of Protocol Data Units (PDUs). The CAL message grows into a packet frame when layers add header information as the message passes down the protocol stack.

sage (in hex) is **10 09 45 43 F5 01**. The F5 preceding the 01 is a DELIMITER token.

Now let's request information from a device by telling it to send us its serial number. The serial number resides in the compulsory universal context 00, node control object 01. This time we use the getValue method (value 43) to retrieve the value of the **serial_#** IV (denoted by ASCII 's', or hex 73). The CAL message is **00 01 43 73**.

If the serial number is SN1234, the reply message will be **FE EC 53 4E 31 32 33 34**. The FE is a CAL COMPLETED token, which tells us that the request for serial number was successful. EC is a token which introduces a LITERAL string. The remaining numbers are the ASCII codes for SN1234.

As a final example, we'll combine the previous two commands with a conditional **if** method (value 56) to turn on the audio muting in a device if its serial number matches SN1234. The CAL message is:

00 01 56 73 E8 EC 53 4E 31 32 33 34 F7 10 09 45 43 F5 01

That's quite a mouthful so let's break it down: 00 means universal context, 01 node control object, 56 if method, 73 serial_# IV 's', E8 is the EQUALS token. EC is the LITERAL token, followed by the serial number in ASCII. F7 is a BEGIN token which introduces a command to be performed if the preceding if method succeeds. The rest of the message was described earlier.

A complete table of CAL methods is shown in Fig.3.

Reporting

In the previous section, CAL messages were composed manually so they could be passed directly to the message transport sub-layer for transmission over the network. CAL also offers an automatic way to create messages, known as *reporting*, by detecting changes to IV's in the context data structures.

Binary Sensor Object				
Label	*R/W*	*Type*	*Name*	*Function*
C	R/W	boolean	current_state	1 = on, 0 = off
F	R	data	function_of_states	
P	R	numeric	previous_state	reporting IVs
R	R/W	data	reporting_condition	
H	R/W	data	report_header	
A	R/W	data	report_address	

Fig.4: The binary sensor reports the state of a two position switch input. It can bind to a binary switch output object.

Refer to the binary sensor object shown in Fig.4. The IV's named **previous_state** (sometimes called previous_value), **reporting_condition**, **report_header** and **report_address** are known as the *reporting quartet*.

CAL periodically scans every object in the context data structures, looking for changes by comparing the object's current_value IV to its previous_value IV. If the **reporting_condition** for that object has been met, then the report_header message is sent to the location specified by report_address.

In the case of a binary sensor object, its current_value is a boolean data type which is set or cleared by the user application according to the state of some type of switch, whether it is a mechanical toggle switch or double-click on a screen icon. A report is generated when CAL detects a change during its next scan.

A reporting condition is established by the user application configuring the reporting quartet, or alternatively by sending messages to set these IV's remotely.

Let's set up the binary sensor object so that it transmits a boolean true or false whenever the switch is operated. The message is to go to a mute switch in an audio amplifier at house code 0001, unit code 5678.

Configure report_condition to 43 ED 00: 43 denotes the current_value IV 'C'. ED is the DELTA token, which evaluates to true if the preceding IV has changed by the amount specified after the DELTA token. 00 is the amount zero, which forces DELTA true for ANY change.

Set report_header to 10 09 45 43 F5: That's 10, audio context; 09 mute setting object; 45 setValue method; 43 current_value 'C', and F5 DELIMITER token. Note that the actual value of current_value is appended after the F5 when the message is generated.

Select report_address as 00 01 56 78: This is the house code of the destination device (most significant byte first), followed by the unit code.

Next time CAL scans this binary sensor object and detects that the current_value is different from the previous_value (because the user application has updated current_value due to a change in switch position), the message **10 09 45 43 F5 00** (or 10 09 45 43 F5 01 if switch closed) is sent to address 0001 5678, and the previous_value is updated to match the current_value.

Chirps

Now that we have looked at CEBus from a software perspective, it's time to turn to the hardware. This section discusses only the power-line carrier media type, since for many users mains wiring is the most convenient way to create a whole-house network.

A power line is a noisy medium, poorly suited to high rate data transfers. CEBus overcomes interference by using the Spread Spectrum Carrier (SSC) scheme developed by Intellon Corporation in the USA.

Unlike the older X-10 system of mains signalling, where just one bit is transmitted per zero-crossing of the mains waveform to minimize noise susceptibility, CEBus message packets can occur during any portion of the mains cycle.

Data is encoded as a sequence of frequency modulated 'chirps' (Fig.5), which sweep from 200kHz to 400kHz and then

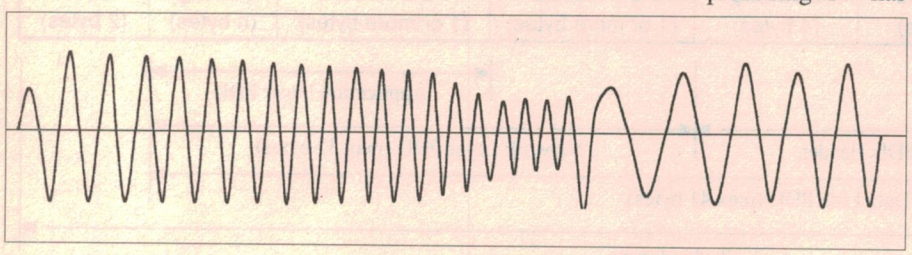


Fig.5: A Spread Spectrum Carrier chirp sweeps from 200kHz to 400kHz and then from 100kHz to 200kHz, in the space of 100us. Each chirp represents the shortest symbol communication time, defined as the Unit Time — allowing 10,000 USTs per second.

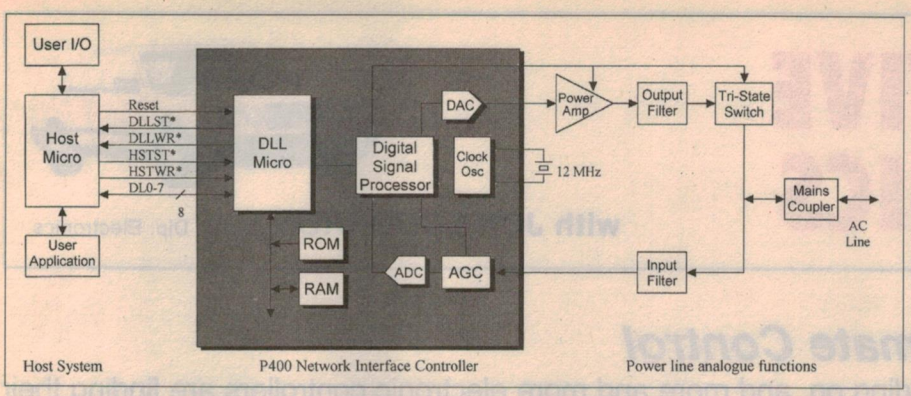


Fig.6: Block diagram of a CEBus node built with Intellon's P400 Network Interface Controller. This 32-pin chip implements the Data Link and Physical layers of the CEBus protocol stack.

from 100kHz to 200kHz, all in the space of 100us. Chirps are generated by a ROM look-up table and digital to analog converter in the transmitter. This unusual waveform is detected digitally by a matched filter correlator at the receiver.

A CEBus message packet body is encoded as a solid block of two types of chirps that are 180 degrees out of phase, known as Superior 1 and Superior 2 states (S1 and S2).

A '1' data bit is encoded as a single chirp and a '0' as two chirps of the same superior state. The superior state alternates between successive bits. For example, the bit pattern 11001011 is encoded as S1 S2 S1 S1 S2 S2 S1 S2 S2 S1 S2. If we assume an equal mix of '0's and '1's, then the power line bit rate is 7500 bps.

Because the network medium is shared, a collision will occur if two devices transmit simultaneously. The same problem occurs in Ethernet LANs, and CEBus solves it in a similar way with a channel access protocol called CSMA/CDCR (Carrier Sense Multiple Access with Collision Detection and Collision Resolution).

To allow collision detection, a modified encoding scheme is applied to a random preamble of '1's and '0's that precede the message body. The '1's and '0's are encoded as chirps and gaps, known as Superior 1 and Inferior states, instead of as a continuous block of chirps.

The inferior states allow the local transmitting station to check for other transmitters during the preamble, since the superior state of another transmitter can be seen through the gaps in the local transmission. If another transmitter is detected, the collision is resolved by the local transmitter backing off for a random delay interval.

Putting it together

While the above description implies that a lot of electronics are required, highly integrated solutions are available today from Intellon in the form of the P400 Network Interface Controller and its lower cost sibling, the P200. Either IC implements the lowest two (shaded) layers of Fig.1.

A block diagram of a system using the P400 is shown in Fig.6. The output amplifier applies chirps of several volts peak to the power line load (as low as 10 ohms for 110V systems, or 40 ohms for 240V). The tri-state switch disconnects the power amplifier from the line during receive (communications are half duplex). The mains coupler contains a small isolating transformer and mains current limiting capacitor.

The host micro is responsible for implementing the Application and Network layers, as well as the user application.

At the time of writing, the closest competing silicon vendor was Domosys Lab Corporation in Canada, which plans to demonstrate its CEWay PL-III at CES-Habitech in June 97, with commercial quantities available later in the year.

For more information

For further information on the CEBus standard, see Grayson Evans' book *The CEBus Standard User's Guide* (The Training Dept. Publications, 1996) for an excellent and highly readable account. Intellon Corporation's website at **http://www.intellon.com** has data sheets, application notes and good articles.

Context lists are available from the CEBus Industry Council's website at **http://www.cebus.org**. For the latest developments in CEBus and home automation in general, visit the HomeToys on-line magazine at **http://www.hometoys.com**.

About the author

Andrew March developed CEBus prototypes for the Smart Company in Fremantle, WA. He was formerly with the Orbital Engine Company. ❖

SHORTWAVE LISTENING

(Continued from page 75)

across the top and the frequency down the side of the page. Some of the bands are quite active and at times up to 180 signals can be identified in a given band.

Several recorders are employed including a Sony, a Sanyo and a talking book machine, while a JVC deck is used for recording the programmes for RNZI. Monitoring is three days in each week for BBC and VOA, and Radio Canada is five days during the transmissions which they allocate, and the times and frequencies to listen to. They all use an SIO code (Signal, Interference and Overall Merit rated from 0-5), and this type of analysis of reception is common to almost all broadcasters.

The BBC and Radio Canada use a standard monitoring form indicating the frequency, time and daily observations, while the VOA have a form in which circles are filled in with a pencil and it is optically read in Washington and put onto the computer.

Aerial changes

Over the years there have been many changes in the aerial systems used. For more than 20 years I had a 53-foot tower with long wire aerials covering almost the length of a city block, but housing development behind our property has meant that the tower had to be taken down in 1992. It has been replaced by a long wire aerial running north, a quarter wave 60-metre dipole and several short aerials for monitoring.

In this area we are fortunate to have a listening post outside the city which is solar powered. It is located in a farmhouse where the local branch of the New Zealand Radio DX League have sole occupancy, and has aerials running up to 1500 feet long — with one bearing on the Eastern United States and another into Northern South America. These are Beverage aerials and they have been installed by the more technical members of the local branch to give the very best reception.

This area is excellent for reception. There is no local interference and it is refreshing to be able to visit this listening post after the difficulties one experiences listening in a city location. The concrete block house has two listening rooms, bedrooms, a lounge and a kitchen and is ideal for group listening — particularly on special occasions when members wish to hear some exotic signals. The site is one which is always used when special St Helena broadcasts are made, as it has always been an area that gives fair to good reception of that signal.

Next month I'll return with the usual column on shortwave listening, including the 'Around the World' summary listing. ❖

AUTOMOTIVE ELECTRONICS

with JON LOUGHRON Assoc. Dip. Electronics

The Ford EA/EB Climate Control

The technology wheel keeps grinding on, and more and more electronic controllers are finding their way into our vehicles. This month we look at the Ford EA/EB series Automatic Climate Controller (ACC). The unit is available on high-end Ford vehicles — that is, the Fairmont, Fairlane and LTD.

The EA/EB Automatic Climate Control system has many features, that can either be manually switched, or if required an automatic mode can be invoked. The 'brains' of the unit resides on the main circuit board. It consists of a 40-pin single chip microprocessor and also has the external interface circuitry and the normal A to D, power supply and decoding logic associated with any micro-based dedicated controller.

Attached to the main board is another board that is interfaced to it via a 20-way flexible cable. (If you ever pull one of these apart you will notice that it is quite a peculiar shape, because it has to fit into the cavity in the dash.) This board monitors the front panel switches and controls the LCD display and various LEDs.

The unit, when it's in auto mode, automatically controls the cabin temperature by looking at various input sensors and then comparing these to what the driver has set as the required cabin temperature, via the temperature 'UP' and 'DOWN' switches on the front panel. Fig.1 shows the layout of the front panel switches, LCD and LEDs.

The ACC unit controls the output devices to maintain the required cabin temperature, so it must be integrated with the heating and air conditioning (A/C) systems. This is quite a task in modern vehicles, even without an ACC system. If you look under the dash in any modern vehicle you will see the design and technology the modern vehicle builders have employed to maintain the creature comforts we have come to think of as 'standard' options.

The ACC inputs are: the set point selected by the driver or front passenger (it is a bit hard to reach the unit from the rear seats); the engine temperature sensor; the sunload sensor; the A/C evaporator temperature sensor; the cabin temperature sensor; and finally the ambient temperature sensor.

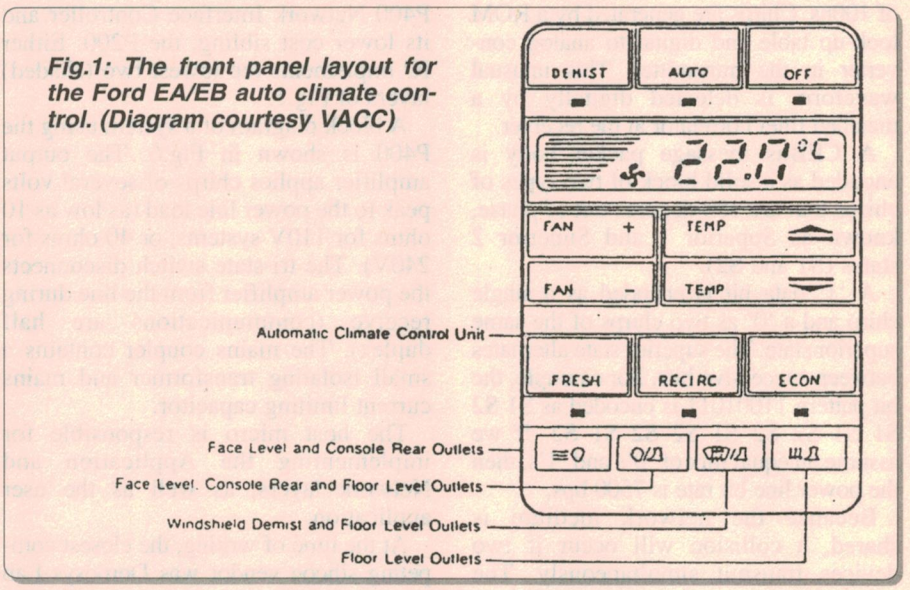


Fig.1: The front panel layout for the Ford EA/EB auto climate control. (Diagram courtesy VACC)

The outputs are: the 'blend' air door position; the fan speed; the A/C compressor clutch engagement; the 'face/screen' air door position; the 'fresh/recirculated' air door position; and the 'floor/screen' air door position. Fig.2 shows a schematic of the system connections to the above input and output devices.

Early, later versions

The front panel of the unit on the early series vehicles is grey and there are 10 LEDs to indicate the off, auto and manual override modes. The LCD informs the operator of the temperature selected, between 16 and 32°C, and also has a 10-segment bar graph on the left hand side to indicate the fan speed. Back lighting for the LCD is controlled in the same as the other dash lights — i.e., the back lighting will dim when the dimming switch is activated on the dash.

When the ignition key is turned on the ACC will be activated and it will display the last temperature, fan speed and function selected.

The later series vehicles have a black front panel and instead of LEDs to indicate which mode is selected, the LCD has pictures and words to describe the operating function. Most of the other functions are the same and the units are interchangeable.

A word of warning, however: Do not interchange the black 'CFC' (a later model type again) for the either of the earlier versions — they are definitely not interchangeable.

Diagnostics

The unit has diagnostic features and also default modes. In fact it can also compensate for some external failures, and can draw your attention to these failures by flashing the LCD for six seconds after the engine is started. If the unit fails altogether due to internal logic or external power supply problems, it enters a default mode, where

the entire system is shut down and air is directed to the screen without fan assistance.

If any problems do exist, the diagnostic mode can be entered very easily by pushing the OFF and FLOOR buttons simultaneously (the FLOOR button is located under the flap, on the bottom right hand corner of the unit). The engine should be at operating temperature and once the diagnostic mode is invoked the unit will go through diagnostics which will take approximately 30 seconds.

During the diagnostic period the micro will exercise the blend door servo motor, and the full hot and cold positions are noted. A continuity check is done to ensure that all of the external devices are connected and within specification. All of the segments on the LCD are activated (so it will read 88.8 during the test) and all LED's should illuminate.

Once the self test is completed and if no faults are detected the display will show 'OFF' and the off LED will be illuminated. If on the other hand a fault is detected by the micro during the self test function, an 'E' with a number from 1 to 7 will be displayed on the LCD to indicate the fault area.

If there is more than one fault, the AUTO button can be depressed to scroll through the individual codes. Once all fault codes have been displayed the unit will exit diagnostic mode on the next depression of the AUTO button.

When a fault is detected, it must then be rectified and any codes in memory can then be erased. This is achieved by running the self test sequence twice. A summary of the fault codes is provided in Fig.3.

Sensor testing

When you are testing the system after a fault code has been recorded and the system will not direct air to the correct vent level or correct temperature, the temperature sensors and vacuum output control devices can be tested. However if one of these is proven faulty, replacement is best left to the experts because some devices are in very tricky positions.

The fan speed control is determined by the ACC, but actual power control is achieved by an external power stage. This has quite a large heatsink, so do not run the fan speed controller for too long without air passing over it (when mounted in the vehicle it is in the main airway). Often when the fan is stuck ON and running at high speed, it is this unit which is to blame and not the ACC.

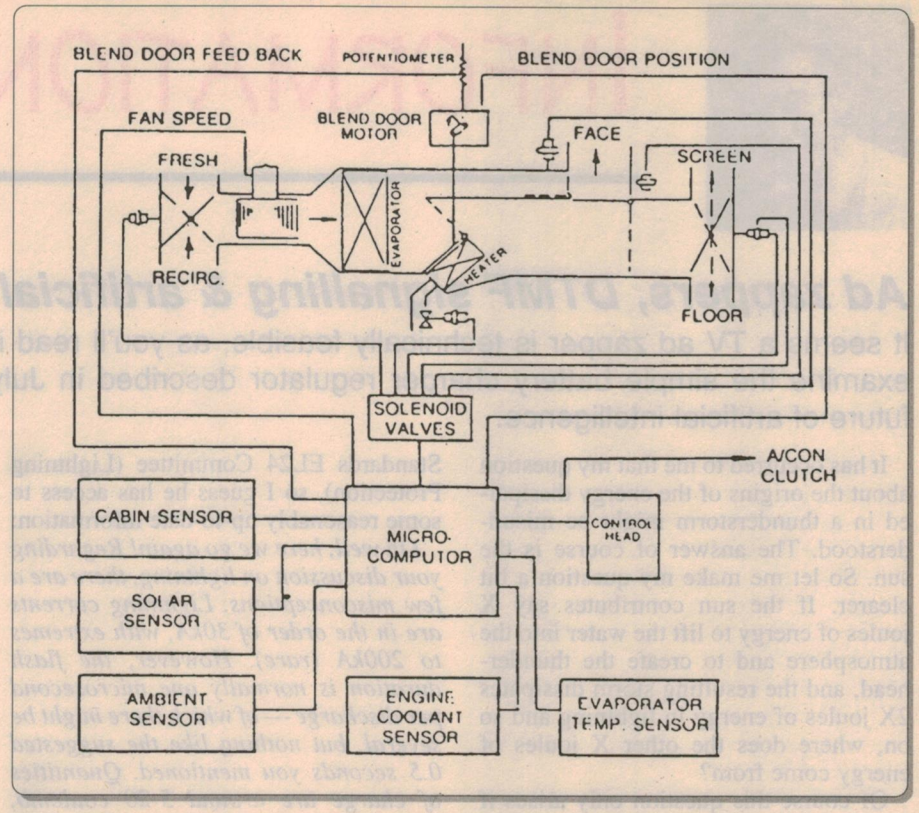


Fig.2: The overall block diagram for the ACC system, showing the various input sensors and output actuators. (Diagram courtesy VACC.)

Common problem

A common problem on the ACC system relates to code E2, which is to do with the blend door servo motor. The ACC has direct control of the servo motor and there is also a feedback pot mounted on a common shaft. If the ACC exercises the motor and does not see the voltage from the feedback pot change, it will load the code E2. Sometimes this can be misleading because the motor could be faulty or the ACC itself may have caused the problem.

I once had a trade customer who had a problem with the servo motor. He replaced it but the system still had fault code E2 loaded. Unfortunately he had forgotten to clear the code, and it took some time and much hair pulling to reactivate the system. It then became obvious that the ACC was also faulty. This is not normally the case; it is 'normally' one or the other — so he was unlucky. The ACC unit was replaced, the codes cleared and his customer drove off happily into the distance.

ERROR CODE	DESCRIPTION
E1	Electronic Control Unit
E2	Blend Door Servo Motor
E3	Cabin Temp. Sensor
E4	Solar Temp. Sensor
E5	Ambient Temp. Sensor
E6	Evaporator Temp. Sensor
E7	Engine Temp. Sensor

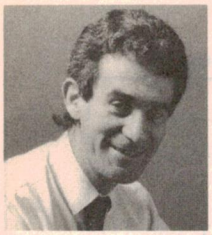
Fig.3: The fault codes displayed by the EA/EB auto climate control system, and the areas they indicate.

The unfortunate thing about the story is that the servo motor is quite hard to get at, and it takes a considerable number of man-hours to access the little blighter. So the moral to the story is: reset the codes when the repair is done, and also check for voltages to the servo motor and feedback pot to ensure the ACC is operating correctly.

Testing the temperature sensors is more straightforward, except perhaps the sunhood sensor which is basically a photodiode. The ACC will load a fault code (E4) if the sunload sensor or wiring is in a short circuit state, but not if an open circuit exists.

The sensor is mounted in the middle of the dash, just near the windscreen and it has to be tested in the dark — so the aperture must be blocked. It can

(Continued on page 97)



INFORMATION CENTRE

by PETER PHILLIPS

Ad zappers, DTMF signalling & artificial intelligence

It seems a TV ad zapper is technically feasible, as you'll read in this month's column. We also examine the simple battery charger regulator described in July, and a reader asks about the future of artificial intelligence.

It has occurred to me that my question about the origins of the energy dissipated in a thunderstorm might be misunderstood. The answer of course is the sun. So let me make my question a bit clearer. If the sun contributes say X joules of energy to lift the water into the atmosphere and to create the thunderhead, and the resulting storm dissipates 2X joules of energy in lightning and so on, where does the other X joules of energy come from?

Of course this question only arises if it's true that a storm dissipates more energy than it consumes. Simple mathematics suggest there's a lot of energy released by a thunderstorm: wind, the potential energy released in falling rain, and of course the electrical energy dissipated as lightning. So how much electrical energy is released?

On the face of it, if a lightning strike has a current of 10kA (a conservative figure) and a strike voltage of 100MV, then the power is 1,000,000MW, or 1TW (T = tera = 10^{12}). The energy is found from the duration of these values, so for a strike lasting one second, 1TJ (terajoule) of energy is used. As one kilowatt-hour equals 3,600,000J (or 3.6MJ), the energy in this particular lightning strike would be 277,778kWh. Put another way, that's enough energy to run 277,778 electric radiators rated at one kilowatt for one hour. Or in terms of a single 1kW radiator, there's enough energy to run it continuously for around 32 years.

Extrapolating, if the above figures are true for one strike, then if a storm generates say 100 lightning strikes, it's the energy equivalent of running a 1kW radiator for around 3200 years. Sounds fantastic, doesn't it? But perhaps there's a problem with these figures (or my maths).

Here's a letter from Brian Byrne, who's no stranger to these columns, and an excellent source of reliable information. Brian is a member of the Australian Standards EL24 Committee (Lightning Protection), so I guess he has access to some reasonably up-to-date information:

Oh well, here we go again! Regarding your discussion on lightning, there are a few misconceptions. Lightning currents are in the order of 30kA, with extremes to 200kA (rare). However, the flash duration is normally one microsecond per discharge — of which there might be several, but nothing like the suggested 0.5 seconds you mentioned. Quantities of charge are around 5-20 coulomb, with an ultra rare value up to 200C.

The voltage before discharge is up to around 100MV, but on discharge (a shortish segment of air at a time, can be 20 to 30 sequences) the only voltage that can be 'collected' is the Ohm's law residue of the last bit of the voltage path (e.g., 30kA into 10 ohms is 300kV).

However try open-circuiting the discharge to bung it into a capacitor. Mr Kirchhoff has arranged plenty of back up — remember the flash has just demonstrated it can break down two kilometres or more of air! (Breakdown voltage of air at sea level is 3MV per metre.) (Brian Byrne, Indooroopilly, Qld)

I guess the main point to draw from Brian's letter is the very short *duration* of a lightning strike. If you know the charge in coulombs and the maximum current value in amperes, it's easy enough to work out an approximate duration of the current.

Let's use the values Brian has supplied of 20 coulombs and a peak current of 30kA. A coulomb is one ampere flowing for one second, so 20C is the same as 20A for one second, or 200A for one tenth of a second and so on. So the duration of this strike is 20C/30kA or around 0.67ms, far less than the second we assumed before.

Even so, for a 1TW lightning strike, the energy for a strike duration of 0.67ms is still huge — amounting to enough energy to run our 1kW radiator for 7.7 days. Not bad for a renewable energy source!

Of course, my question has nothing to do with capturing the energy contained in a lightning strike, as too much is lost. Rather I'm interested in how the energy is released, and in particular, where it comes from. But if the energy to create the storm equals the energy the storm dissipates, then we know where the energy comes from: the sun.

So I guess I need to rephrase the question: does the energy released by a storm exceed the amount of energy used to create it, and if so, where does this extra energy come from?

But even if there's no 'extra' energy, the mechanics of a storm are still a source of great wonderment. Perhaps understanding the mechanism could lead to another method of generating electricity. I'm most interested in your comments, and thank you Brian for your contribution to the question.

Getting back to basics, next we have a discussion on the operation of the Add-on Regulator for 12V Battery Chargers, described in July 1997.

Battery charge regulator

This simple project has proved very popular, with most parts suppliers now stocking a kit of parts. It has also been the subject of a few questions, which have come from various sources such as phone calls and general enquiries. Here's the first:

I was told the pulsed charge current supplied by the regulator could damage the plates of a 12V car battery. Is this true?

Certainly not. A typical car battery can happily supply over 100A of discharge current, while this circuit delivers a peak current of less than 5A. We also tested this project on small gel batteries (6Ah), and found the batteries didn't even get warm, let alone suffer any damage.

Could I build this charger into my car? I seem to be unlucky enough to always end up with a faulty battery, and

I'm forever needing to charge them. By installing a charger in the car, I can simply run an extension lead to the car and plug it into the charger which is permanently connected to the battery, via an isolating switch.

We don't recommend this, as apart from possible safety problems associated with having a 240V appliance mounted in a car, it also limits the use of the charger. As well, the charger will be exposed to the bumps, heat and other hazards you get with a car.

A better way might be to mount a cigarette lighter socket on the car (behind the grille) and to connect the battery to this socket. The charger is then fitted with a cigarette lighter plug, so it's then easy to connect or disconnect it. This lets you use the charger elsewhere, and gets around the other problems I've mentioned. You can buy cigarette lighter plugs and sockets from most auto accessory shops.

Why is the SCR in the charger pulsed at 40kHz? An SCR starts conducting when the gate is pulsed and doesn't stop conducting until the current through it drops sufficiently. As the supply to the SCR is simply rectified 50Hz AC, surely a much lower triggering frequency can be used.

Say for example you pulse the gate at the start of the AC waveform across the SCR. The SCR will stay on for 10ms then turn off when the voltage across it drops to zero. It then needs another pulse to turn it on, but surely you could have used a triggering frequency of 1kHz or less, as the time between pulses is only one millisecond.

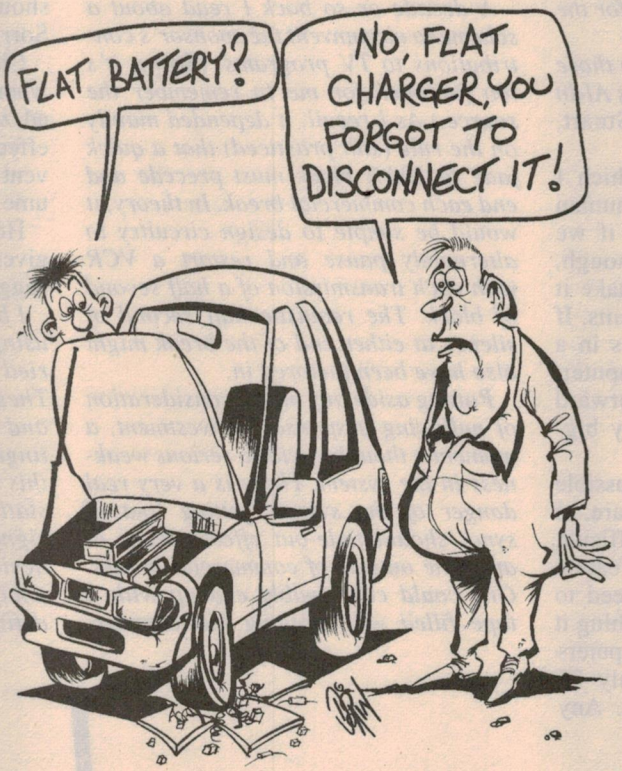
For this question, I asked the designer Heinz Harle to comment. He writes:

In the text of the project I said 'Because the oscillator is running at a frequency of about 40kHz, there's very little RFI, as the SCR is always triggered close to the zero point of the input voltage'. That's perhaps over simplified, so here's a more accurate and detailed explanation.

The SCR can only conduct when its anode voltage is more positive than its cathode voltage, and a suitable gate signal is applied. To put it another way, the transformer's secondary (rectified) voltage (at the SCR anode) has to rise about a volt or so above the battery voltage, which is present at the SCR cathode, before the SCR is able to conduct. This occurs at around 60 to 70° of the waveform cycle.

To ensure the SCR conducts with the minimum possible anode to cathode voltage difference, a high gate pulse repetition rate (PRR) is needed. Any frequency between 10kHz and 50kHz is adequate. I chose 40kHz as it seemed to work well with various SCRs and pulse transformers. A 1kHz PRR will allow the anode-to-cathode differential to rise to a higher value before triggering occurs, resulting in a higher switch-on current, producing more RFI.

This happens because the SCR might not necessarily trigger on the first or even the second pulse, delaying the point at which it finally triggers. An SCR will only trigger and remain on if the load current is above the hold-on current, so it's good practice to supply lots of trigger pulses to ensure turn-on as soon as possible in the cycle.



Summarising, SCR current starts flowing at around 60°, and stops flowing at 120° after the start of each half cycle of the supply voltage. The actual values depend on the state of charge of the battery, and the current rating of the charger.

Incidentally, this also applies to most full wave rectifier type battery chargers. That is, current only flows for around one third of the overall supply cycle.

'Sojourner' and artificial intelligence

If there's any event this year that has captured the public interest, it is surely the recent landing on Mars. NASA is even claiming the 'biggest Internet event ever' with its site showing 'hyperview' photos direct from Mars. Certainly it's a huge technical achievement, although some might regret learning that Martians don't exist. But as our next letter points out, despite the success of the mission, we still have a long way to go.

Your recent correspondence on the subject of 'ad zappers' brought some thoughts to mind. That is, despite the huge advances made in recent years in computing power and software development, no one has yet produced a device which can do what any five year old can do: tell you when an ad comes on TV.

I presume this is because an ad interrupts the thought process along which the human brain is being led by the TV program. Computers on the other hand are binary devices, capable of making only programmed yes/no decisions, based on measurable input data. Advertisements do not have any measurable physical quantity to distinguish them from the feature program. This leads me to wonder whether artificial intelligence (AI), will ever replace a person's brain. Perhaps someone in the AI field could comment.

The recent Mars landing and exploration is an interesting example of how much AI can achieve. Both the lander and the self-propelled rover ('Sojourner') must have had huge amounts of computing power on board, all programmed to be intelligent enough to operate without real-time control from Earth, because of the 10-minute signal delay to and from Earth.

However, when the time came for the rover to exit down a ramp from the lander, it was discovered that an airbag was partly covering the ramp, blocking Sojourner's path. (At least this is what the press reported.) This was unexpected and could not be solved by the on-board computers. The solution had to come from Earth.

This leads to the question: 'What is intelligence?' Dictionaries tend to express it in terms of mental ability. In

the context of this discussion a better definition might be 'the ability to solve a problem which has not been encountered before'. Humans are capable of this, but I doubt whether a computer (as we know it) could achieve this feat.

Computers have no 'nous' and thus can only handle problems they are programmed to solve. The Mars rover was programmed to handle every expected obstacle, but could not handle an unexpected one. Yet a five year old child could have dealt with the airbag in the same way it could deal with a TV ad, even one which was being shown for the first time.

I trust this letter will encourage those more qualified than me to discuss AI in your column. (Peter Stuart, Carlingford, NSW)

An interesting point Peter, which I guess asks the question: is the human brain like a computer? That is, if we can increase computing power enough, can we ever write software to make it able to handle unexpected problems. If however a human brain operates in a totally different way to a computer, then perhaps all we can look forward to are computers that are simply bigger, or go faster.

Personally I avoid wherever possible using so-called 'intelligent' software, as it usually makes the task more difficult. Windows '95 and its plug 'n play feature is one example, in which you need to fight the software to install something it doesn't recognise. But then, computers as we know them are really only 25 years old, so it's early days yet. Any comments on AI?

Ad zapper

In July, I included two letters about eliminating TV advertisements, with the term 'ad zapper' becoming increasingly favoured as the name for such a device. I have several more letters on this topic, with the following letter scotching the US device described in July. However, read the second letter as well, as it seems there could be a reliable way to tell between ads and programs.

I feel the explanation given by the VCR salesman is extremely questionable. No sane broadcaster, USA or anywhere, would deliberately decrease transmission power outside a commercial break and risk losing fringe reception viewers. Besides, unless reception is very weak, increasing transmitter power does not result in a perceptible brightness or loudness increase. The receiver's AGC system would take up the difference, leaving an improved signal-to-noise ratio (less 'snow') as the only detectable result.

What this salesman might have misinterpreted is the common practice of severely compressing the audio on most TV ads, resulting in a higher average sound level and a subjectively louder result. Incidentally, this level is never louder than the higher peaks heard in normal programs, but try and convince the average viewer of this.

A decade or so back I read about a scheme to circumvent the sponsor's contributions to TV programs. (Sorry, it's too far back for me to remember the source.) As I recall, it depended mainly on the rule (still practiced) that a quick fade to 100% black must precede and end each commercial break. In theory, it would be simple to design circuitry to alternately pause and restart a VCR with each transmission of a half second of black. The requisite half second of silence at either end of the break might also have been factored in.

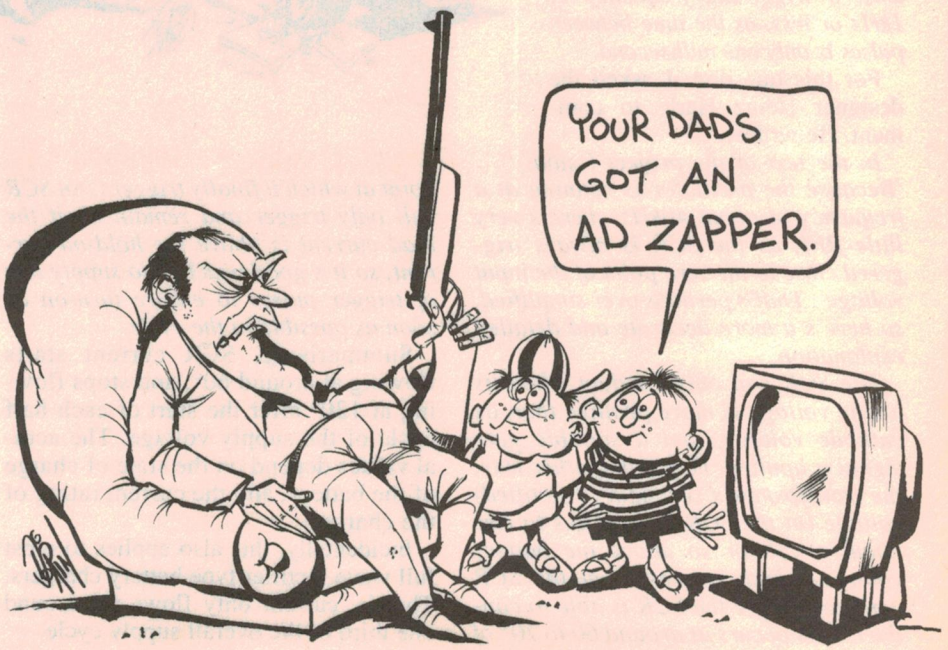
Putting aside any moral consideration of nullifying a sponsor's investment, a moment's thought yields a serious weakness in the system. There is a very real danger of the system getting 'out of sync' should fade-out effects occur at any time outside of commercial breaks. One could conceivably end up with a tape filled with nothing but commercials, scarcely fulfilling the original intent. Little surprise that the whole idea 'faded-to-black'. (Charles Slater, Fairy Meadow, NSW)

Charles, your comments are similar to those in a letter from Marcin Frankowski (Wellington, NZ), who also makes the point that as TV sound transmission is FM, changing the carrier amplitude will have no effect on sound level. (Incidentally, Marcin has pointed out that I've aged him by 30 years, by editing his letter in July to read '... a scope I owned in the '60s'. It should have read a 60's model scope. Sorry, Marcin!)

Charles has also reminded me that when I discussed the operation of the US ad zapper in July, I didn't mention the effect of AGC. It alone is enough to prevent amplitude changes affecting volume. So much for sales talk!

However, the next letter on this topic gives some technical information that suggests an ad zapper IS possible:

I believe an ad zapper could be built, using the data signals which are carried in the vertical blanking period. These are used to identify programs and there should be some way of distinguishing the commercials by using this data. It would be difficult for TV stations to change the format of these signals, and the only answer to a device based on this idea would be to encipher the data. The format is defined in standards and I understand



it's a universal one. (Harry Freeman, Wollstonecraft, NSW)

I was not aware of this, Harry. It's most interesting, as this may well be a way of identifying an ad. Perhaps the device mentioned in August used this method.

Of course, it's also interesting to speculate on the future of a commercially available ad zapper. You couldn't advertise it on TV, as it would blank out its own promotion. And imagine the chagrin (let alone the law suits) of advertisers, TV station proprietors, the advertising industry and so on.

And is such a device morally acceptable? I don't know, but I'd sure love to own one!

DTMF signalling

In July I included a letter from reader Ben Low, which explained why a young reader had asked for a particular oscillator design in May. It seems he was interested in building a 'coloured box' — the name given to a device that fools the public switched telephone network (PSTN). As Ben pointed out, the device wouldn't work anyway. The next letter tells us a bit more about the use of DTMF tones with the PSTN:

I would like to add to the comments by Ben Low on DTMF signalling. I realised the motive behind the original request, but did not bother to write about it, knowing that the device would not work.

The particular frequencies were used in the USA from about 1943 in the trunk and local network, and action to replace the DTMF system began in 1976. I doubt if any of it remains in service, although it may still be around in some odd corners. The same frequencies were used all over North America and, I think, in Japan, but most countries used other systems.

In Australia a 2VF system was used from 1940 using 600Hz and 750Hz, as well as a variety of local systems using frequencies around 2400Hz. These were all replaced by 1970 with a signalling system which was more elaborate than that used by the Bell System. It used frequencies spaced at 120Hz intervals from 660Hz to 1980Hz.

This in turn has now been almost completely replaced by the CCIT No.7 system, which separates the signalling and speaking paths.

By good fortune, rather than planning, the Australian telephone system was harder to frustrate. As far as I know, only one of the American rainbow coloured boxes was successful in Australia. This was attached to a particular telephone and allowed free calls to be made to that number. (Usually a student calling long distance to his girl friend or parents.) It tripped the ringing without starting the metering process. It only worked on some 'step by step' numbers and although the APO devised schemes to counter it, it was decided to do nothing.

The present signalling system is believed to be immune to any attempts at fraud. Signalling uses a separate network and there is a 'firewall' between the signalling from the customer's telephone and the signalling network. ISDN customers have access to the signalling network, but only a limited class of messages are allowed to be sent.

Modern telephone systems are interesting and by no means as difficult to understand as the older crossbar and step by step system. Perhaps an article in Electronics Australia about them might be worthwhile. (Harry Freeman, Wollstonecraft, NSW)

Thanks again, Harry. As you can see I broke your letter into parts. It's interesting that modern telephone systems are easier to understand than the old relay systems. Perhaps an article would be in order, as I know readers would be interested. We'll look into that one.

I remember the old system quite well, as my father was a telephone technician. I visited many exchanges as a child, and still remember the smell, the sounds and the huge racks of uniselectors, relays and other amazing mechanical devices. These days the uniselectors and relays are gone, replaced by digital electronic modules that are silent, compact and so much more reliable. But not as exciting to watch, you have to admit!

And now for the last part of Harry's letter, which asks a question about UHF channel numbers.

UHF channel numbering

I have a small problem with UHF TV channels. I have to use the Kings Cross translator and my TV and VCR seem to have different ideas about channel numbers. The translators are on channels 46, 49, 52, 55 and 58, and my new VCR picks them up on these channel numbers. However the TV, which is about 10 years old, picks them up on 44, 46, 49, 51 and 54. I have only found this out recently when I bought a new VCR, as the old one had manual tuning.

There is no doubt that the two sets are picking up the same stations; I am not picking up other translator sites. This is not really a problem, but I wonder if there is more than one UHF channel standard and that the old set was built for a different country. I always thought UHF channel numbers were a world-wide standard. (Harry Freeman)

In case you're wondering, the Kings Cross translator Harry refers to was installed to overcome TV reception difficulties in the eastern part of Sydney. It re-broadcasts all TV stations, but on UHF. Many viewers can pick up both the VHF and UHF transmissions, so you simply choose the best one.

I'm tempted to say Harry, if you don't know the answer, it's unlikely many others will! Harry is well known for his knowledge of most aspects of telephony and related subjects. Still, perhaps a reader might know and can help.

What??

It seems readers enjoy questions known to have fooled others. The contributor for this month's teaser is Paul Hetrelezis (Noble Park, Vic), who says a similar question was given as an aptitude test to prospective employees of a well known computer firm, and only one in 50 applicants could solve it. It's not a trick question:

John, Paul, George and Ringo are about to record their Abbey Road album. The four of them are at one end of the famous pedestrian crossing. The other end of the crossing leads to the recording studio. They have 17 minutes (maximum) for all four to get to the other side.

All four need to cross, but they have to carry a searchlight due to a power blackout. Also they must only cross as a pair of any combination, but are allowed to return alone to the starting point. Any pair only crosses as fast as the slowest person (see below). For example if John crosses with Ringo, the time elapsed to cross is 10 minutes, and it takes John one minute to return to the start. You have five minutes to solve the problem.

Here are the times to cross the pedestrian crossing: John — one minute; Paul — two minutes; George — five minutes; and Ringo — 10 minutes.

Answer to September's What

This problem can be solved with simultaneous equations, based on the equation to find the series impedance of a RL circuit: $Z^2 = (2\pi fL)^2 + R^2$. The first two equations, after resolving any numerical squares are:

$4(\pi fL)^2 + 4R^2 = 28{,}900$ (1)

$16(\pi fL)^2 + R^2 = 19{,}600$ (2)

Multiplying (1) by four gives:

$16(\pi fL)^2 + 16R^2 = 115{,}600$ (3)

Subtracting (2) from (3) cancels the inductive term and gives $R^2 = 6400$. Therefore resistor $R = 80\Omega$. ❖

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AUTO ELECTRONICS

(Continued from page 91)

SENSOR DESCRIPTION	RESISTANCE @. 20 DEG C
Cabin Temp.	2.25 - 2.75 K ohms
Ambient Temp.	1.90 - 2.30 K ohms
Air-con Evap. Temp.	1.70 - 2.10 K ohms
Engine Coolant Temp.	2.30 - 2.70 K ohms

Fig.4: resistance vs temperature characteristics for the various sensors in the ACC system.

then be tested as a normal diode, although it may have to be removed from the dash to test it.

The testing of other temperature sensors is quite simple. The resistance will change as the temperature changes, and the specifications are given in Fig.4 for the cabin temperature sensor, ambient temp sensor, air-con evaporator temp sensor and the engine coolant temp sensor at 20°C.

The cabin temperature sensor has a cabin air 'sniffer' motor dedicated to it, and it is used to draw cabin air over the sensor when the control unit is switched. When testing the unit, make sure you check that air is drawn in through the opening in the sensor air register.

The other outputs on the system are vacuum controlled, and when the direction of the air is selected — such as floor, face or screen — the appropriate flap will be activated by the relevant vacuum solenoid. The relevant vacuum solenoid is energised (i.e., electrically controlled) by the ACC.

Testing the vacuum system is the same for any vac system. Simply ensure there are no leaking valves and that all flaps have full movement and are not jamming.

The mechanical 'bits' under the dash take quite a bit of work to get to, but electrically testing the ACC can be done relatively easily. The speedo facia has to be removed, then a couple of screws removed from the ACC mounting bracket lets the ACC be pulled out of the dash. You can access the connectors while the unit is still connected to ensure outputs and inputs are operating correctly.

Just remember that when you decide to become adventurous and start removing bits of the dash, all those screws, bolts and plastic bits did in fact hide under the dash somewhere! It's important to remember *where*, so you can put them all back afterwards.Until next time, 'bye. ❖

EXPERIMENTING WITH ELECTRONICS

(Continued from page 49)

all of the time, then our resistor has a resistance of whatever the CMOS switch is, and it will depend a bit on the supply voltage. Over the 3 — 15V DC supply range, it's typically somewhere between 330Ω and 80Ω.

But if the switch is open, the resistance is 100kΩ. So what happens when the switch is closed for only half the time? In that case if we have what's known as a 50% duty cycle, then the average resistance should be about 50kΩ, or half the maximum off resistance. If we have a 75% duty cycle (that is, the switch is on for three-quarters of the time), then we should get an average of one-quarter of the resistance or 25kΩ.

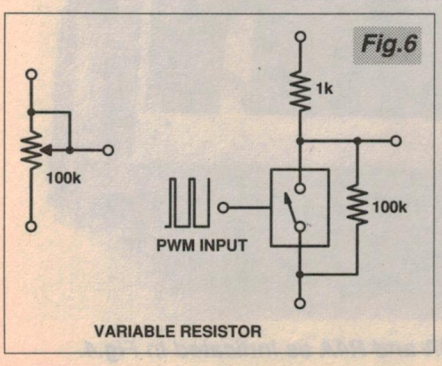


Fig.6

Well, that's what it should be in theory. The average resistance is inversely proportional to the duty cycle of the switch.

If you have access to a CRO, here's a circuit which will let you find out for yourself.

The two-switch oscillator in Fig.7 (using IC1a, IC1b) has a variable duty cycle, thanks to pot VR1 and diodes D1 and D2, but a constant frequency. Connect the CRO input to pin 8 of IC1c and set the trace so that a full cycle fills up 10 grid squares across the screen. You may need to manually adjust this to fit. Next adjust the duty cycle so that it is as close 50% as you can get it — i.e., five grid squares equalling half a cycle. Then measure the voltage across the 0.1uF capacitor and then measure the supply rail. Divide the latter by the former and you should get fairly close to 0.5 as an answer.

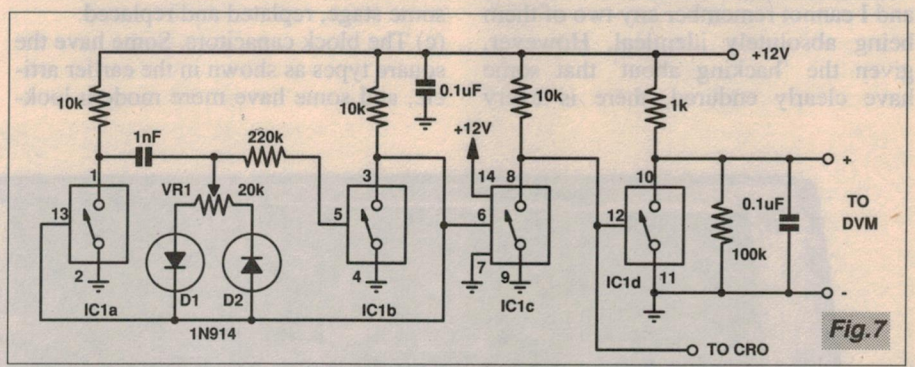


Fig.7

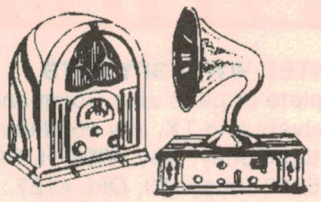
Try some other duty cycle factors like 25% and 75%, perform the same procedure and see what the voltage works out to. Notice that the 0.1uF capacitor across IC1d averages out the switching, to produce a steady DC voltage you can measure with your multimeter.

I'll leave you to come up with your own conclusions — after all, that's what experimenting with electronics is all about!

See you next month. ❖

Vintage Radio

by ROGER JOHNSON



Revisiting the Philips 2510 receiver

This novel receiver, generally known as the 'tin trunk' set, was discussed in this column by Peter Lankshear back in October 1991. Six years later, it is time to have another look. The 2510 dates from 1929 and was Philips' first export model, being sold widely in both Australia and New Zealand.

Anyone who has attempted a restoration of this remarkable receiver is most likely to both curse and adulate the wretched thing in the same breath! For those contemplating a repair or restoration, the previous article will probably need to be read in conjunction with this column. The identification of circuit components in this text relate to the component markings published with the circuit in the earlier article, which we're also reproducing here for convenience.

To begin, it might be as well to point out the subtle variants. Speaking personally, I have owned, repaired or inspected about a score of these sets, and I cannot remember any two of them being absolutely identical. However, given the 'hacking about' that some have clearly endured, there is every chance that there may well have been identical sets in their original state.

Listed below are most of the variations:

(a) Earlier and later sets, denoted by the number of stars on the front escutcheon. This was fully discussed in October '91.

It would appear that the earlier six-star models are not as prolific as the later models, and the following observations relate to the later models:

(b) The dial escutcheon. Some are burnished copper to match the escutcheons on the side panels, while others are nickel plated. It is most unlikely that the front escutcheon has been removed at some stage, replated and replaced.

(c) The block capacitors. Some have the square types as shown in the earlier article, and some have more modern-looking can types painted blue with the 'Philips' logo stencilled on them.

(d) The RF coupling capacitors C16 and C9. Some are enclosed in red empire cloth or cambric cloth tubing as described in the earlier article, while others are of the moulded bakelite type with solder lugs, are firmly soldered to the grid pin of the appropriate valve and are mounted vertically.

(e) In some receivers the anode decoupling resistors R4 and R8 are divided into two parts, which are now designated R4A and R4B etc., in the under-chassis diagram.

(f) The coil cans. In some sets they occupy almost the entire width of the partition, while in others they occupy about half the width, clearly revealing the vanes of the quite impressive tuning capacitor.

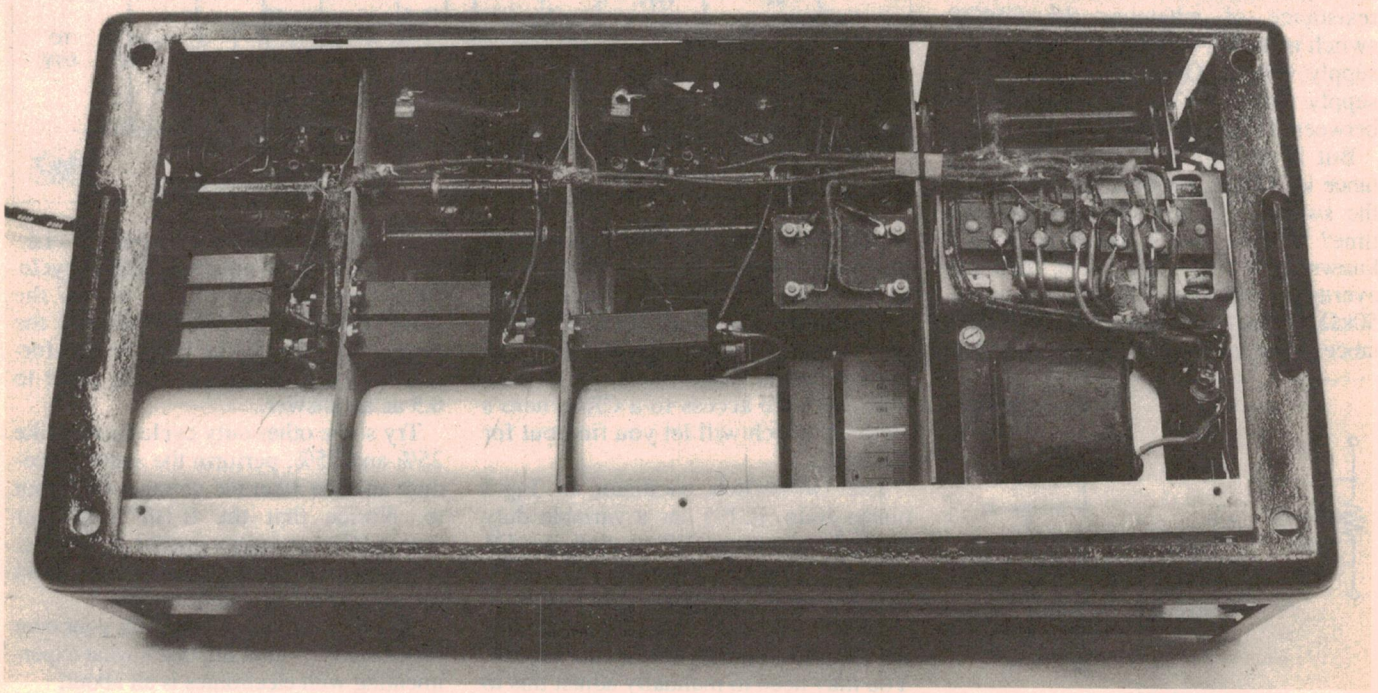


Fig.1: Underneath a 2510, probably of the later variety. Note the capacitors, and R8A and R4A as indicated in Fig.4.

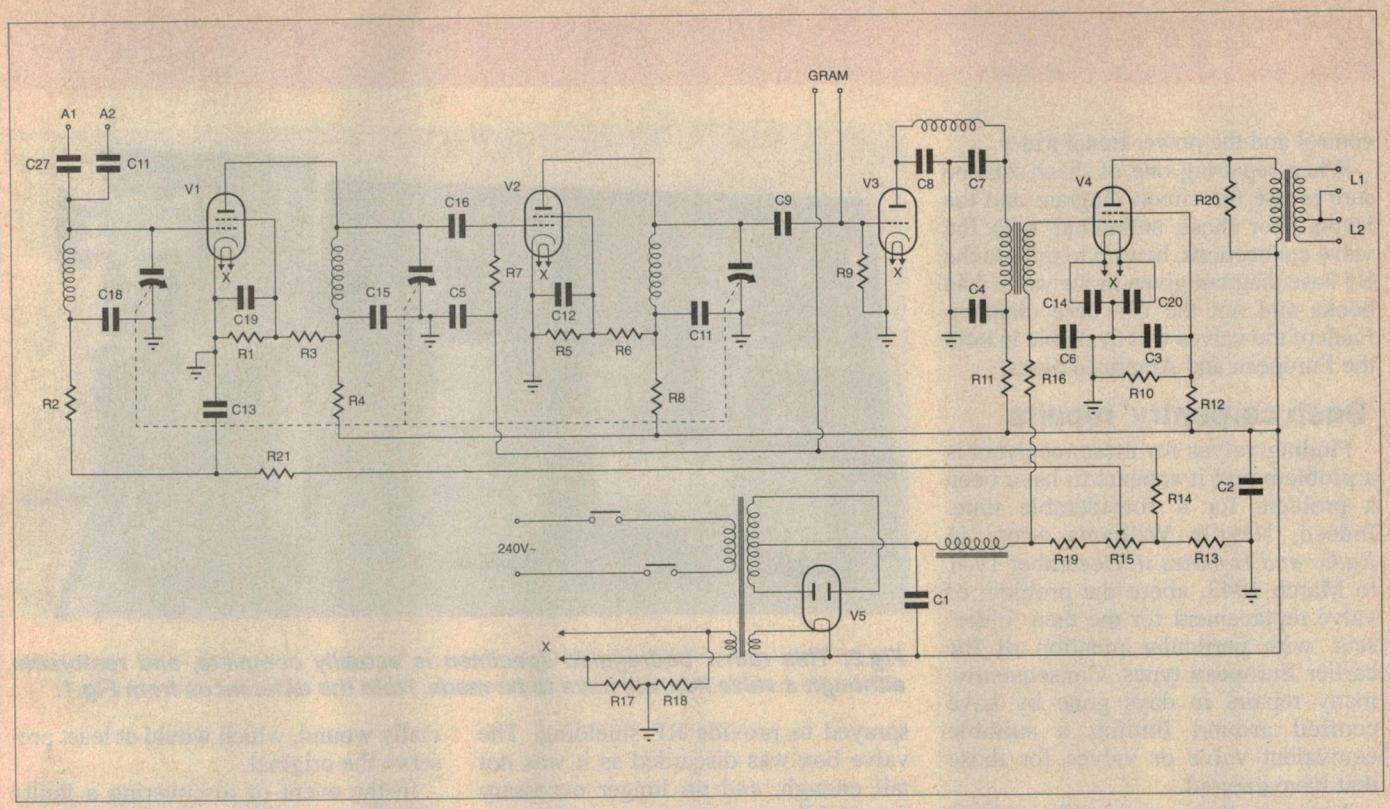


Fig.3: To refresh your memory, and for convenience, here's the schematic for the 2510.

(g) Not all sets had 'A1' and 'A2' antenna connections.
(h) The lid lock. Some had the lock and key, others did not. It is fairly easy to see if there would have been a lock, because the hasp is most likely to be still retained in the lid, even if the mechanism has since disappeared. Of the ones fitted with a lock, some had a key escutcheon, others did not.
(i) Supply voltage. This needs careful attention. On the rear panel is a maker's plate which states the model number (stencilled) and stamped on the plate is the supply voltage and the serial number. Quite a few of these sets are for 210V AC only, and SHOULD NOT be run at 240/250 volts. If the plate is missing, which is unfortunate, the only way to tell is to connect 4V AC to one of the filament windings and then measure the voltage on the transformer primary.
(j) Finally, some sets had a small tinplate rectangular window with a fine wire soldered across the rear opening, to form the reference line for the dial reading. This little window was fixed to the back of the inside of the lid, directly behind the dial escutcheon and fixed with the same rivets. In other sets, the dial reference line was a small piece of fine wire affixed to a small fibre upstand which was bolted to the chassis.

So there we have two classes of 2510, and within the second class there are nine different sub-classes each with two possibilities.

Construction

Although Philips produced sound designs which performed well, their manufacturing engineering was, depending upon one's point of view, either 'simply unorthodox' or 'a rotten flamin' mongrel'. Those who are more kindly disposed are Philips enthusiasts, others are not!

It is difficult to see an American manufacturer engaging in the rebated lid, and the very tricky pieces of sheet metalwork of the power supply cover, the valve box and the large fully enclosed tuning gang. Then again, it would be a dull world indeed if everything was the same, and the pleasing lines and proportions of the 2510 contribute to its beauty and appeal.

Layout

The sketch of Fig.4 shows the location of the major components. Figs.5 and 6 show the connections to the terminal strip and the capacitor box. These have been traced over many hours by the author, and are not taken from official service literature. Figs.7 and 8 show the connections to the volume

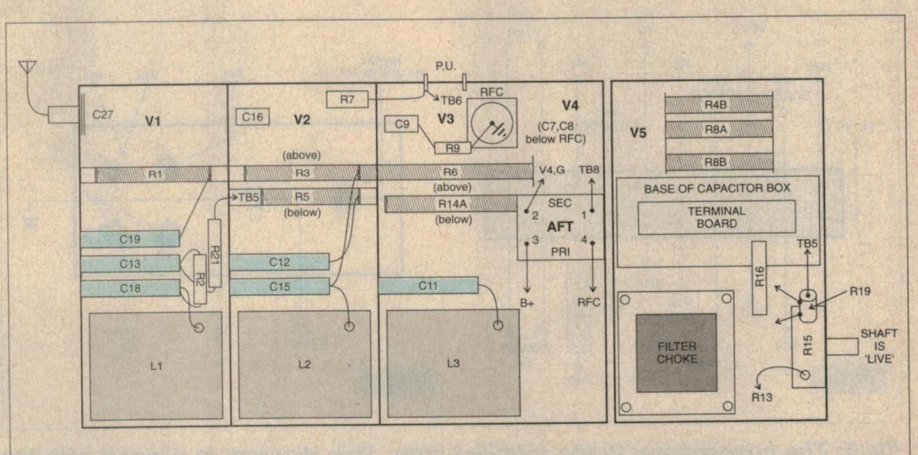


Fig.4: This diagram shows the location of the major components visible in Fig.1.

control and the power transformer.

When repairing one of these sets, be sure to use the circuit diagram and the layout. For those unfamiliar with the valve connections, be sure to refer to the B5 base diagram given in the valve data books and not the UY base diagram. Each of the valves was available in both the European and American bases!

'Bush carpentry' repairs

Finding valves for these receivers is a problem and it appears to have been a problem for a considerable time. Indeed, Neville Williams wrote in *Radio and Hobbies* in December 1941 to March 1942, about the problem of valve replacement for the then 'older' sets, with particular mention of the earlier European types. Consequently, many repairs in days gone by have centred around finding a suitable equivalent valve or valves for those that have expired.

Amongst these repairs have been substituting a standard type 80 rectifier for the 506, running it on the same 4V heater winding and 'hoping for the best'. Other attempts were to replace the valve sockets with the 'P' type and substituting types AF3 for the RF amplifiers, a 'whatever' for the detector, and an AL3 for the output valve.

I found that another would-be repairer had mounted a small auto-transformer under the chassis to step up the heater voltage to 6.3V, and inserted three type 6SH7's and a 6V6-GT for the original lineup. Yet another attempt was the substitution of the taller E452's. These valves were metal

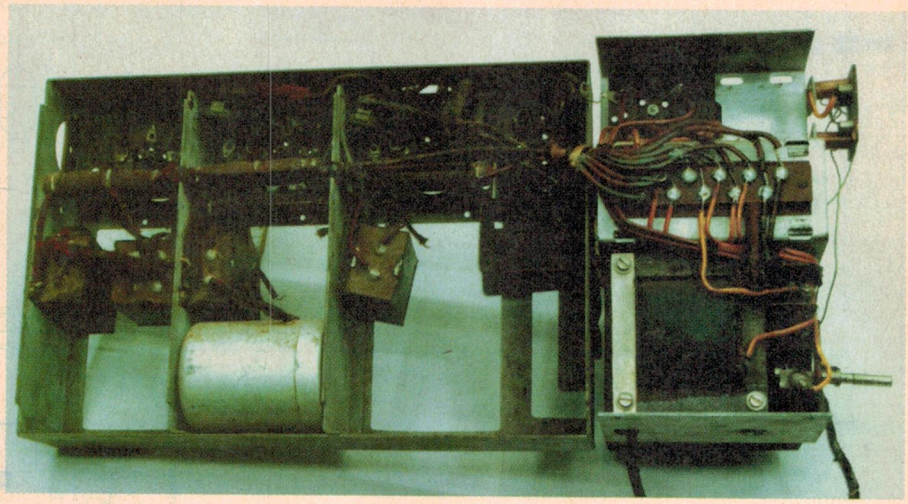


Fig.2: This rather bedraggled specimen is actually complete, and restorable, although a valve box will have to be made. Note the differences from Fig.1.

sprayed to provide RF shielding. The valve box was discarded as it was not tall enough, and no longer necessary for shielding purposes.

Getting them going

The following comments and suggestions are to effect temporary, reversible repairs to a 2510 until the correct component can be obtained.

Firstly the power supply. For those sets with a 210 volt primary, the set must either be used in conjunction with a mains stepdown transformer, or a 'Variac' variable transformer. Otherwise, the power transformer will have to be removed, stripped and rewound — which is time consuming and expensive. It may be cheaper to have a 210/240 auto-transformer especially wound, which would at least preserve the original.

In the event of discovering a faulty transformer with a 210 volt primary, common sense suggests that it should be re-wound with a 240V primary. Unfortunately there is practically nothing at all with which the power transformer can be substituted.

The replacement of capacitors has been dealt with in the previous article, and the accompanying diagram should be of benefit in locating the individual connections. The repair of the resistors is similarly covered.

The next and biggest problem is likely to be the valves. The degree of difficulty for each types in ascending order would surely be (1) the 506, (2) the E415, (3) the E442 and hardest of all, the output valve C443.

Incidently, there is a difference between a 'C443', a 'C443N' and a 'C443N series 250'. They each have different characteristics. If you use a type PM24A, the ratio of the output transformer will be upset as this valve requires an optimum load of 8000 ohms, as opposed to 15,000 ohms for the C443. Otherwise, the other characteristics are almost identical.

The PM24B is the direct equivalent of the E443N, and the PM24M is the direct equivalent of an E443H. Of the two, PM24M/E443H is by far the most suitable, and the other should not be considered. An E443H with 200 volts only on the screen will probably draw plate current fairly similar to the C443.

Another reasonable substitute could be the Tungsram type PP4, with Brimar

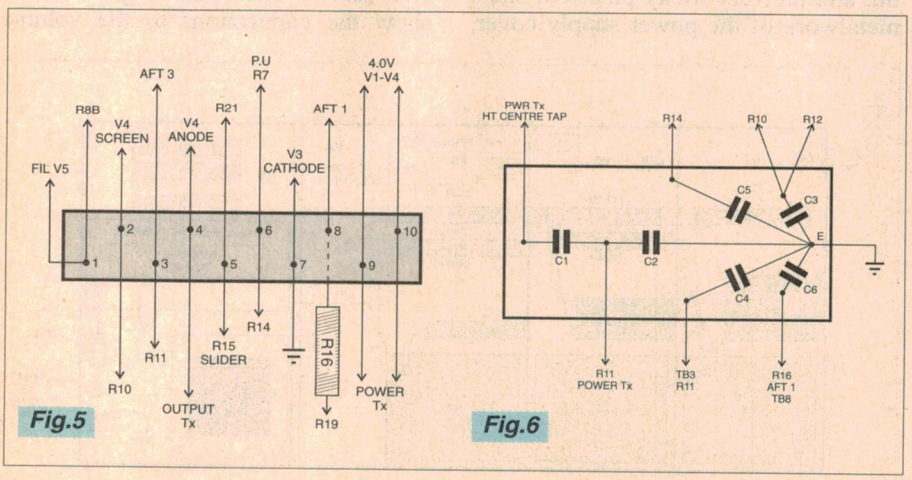


Fig.5: The connections to the terminal strip. This diagram is aligned with the location diagram of Fig.4.
Fig.6: The connection to the capacitor box.

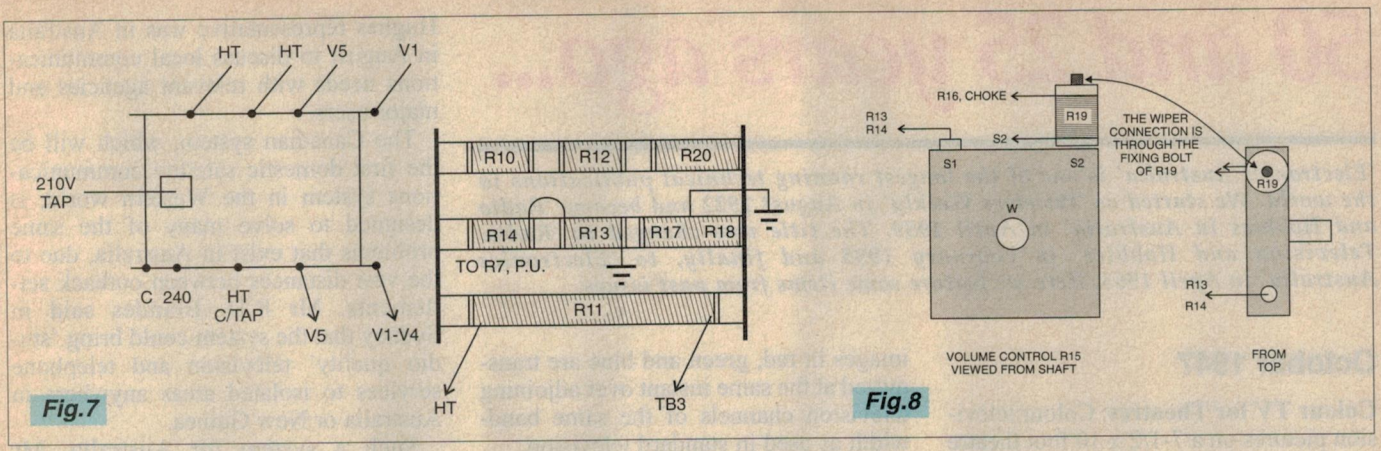


Fig.7: The connections to the power transformer and resistors inside the power box.
Fig.8: The connections to the volume control.

PenA1, Cossor type PT41 or Triotron types P425 and P435 being the only other candidates. All of those types, together with PM24A and PM24M, draw 1.0A heater current which is in excess of the modest 250mA of the C443. If using those types, it may be as well to use the high impedance connection of the output transformer and operate the speaker via a speaker/transformer of the conventional type. Otherwise, the mismatch may be too great if using the voice coil of a modern speaker direct to the low impedance tapping, causing noticeable distortion. This of course assumes that a 'Sevenette' or PCJJ speaker is unavailable.

How does one allow for the increased heater current? Simply by removing the dial lamp! The bulb is of the motorcar tail lamp variety, generally rated at 3W. Operating at 4.0 volts, the rating might fall to 2.5W or so, which means it still draws about 0.75A — which is the difference required to run the substitute valve types.

As for the RF pentodes, there are a reasonable number of types available. Some might not have the bakelite screw type top caps of the older European valves, but rather have a modern style of top cap. This can usually be carefully removed, and the top cap from a dud valve placed in its stead. If the correct valve types can be procured but with UY bases, then with care, those valves can be re-based.

The alternatives for the other valves were covered in the previous article.

Frame & cabinet

Now let's talk briefly about restoring the frame and cabinet panels. If the paint has seriously deteriorated, or the metal has become rusty, it is best to remove the panels by carefully unscrewing the BA fixing screws, using generous doses of penetrating lubricants, and sliding out the panels. Then have the frame grit blasted. The frame will need to be sanded smooth with several grades of 'wet and dry' paper, primed, undercoated and finished off with a quality, semi gloss black spray can paint. The panels can be given a vigorous polish with an extra cut automotive polish.

In operation

The gain of these receivers is quite sufficient for full power to be obtained with using merely three or four feet of antenna, such is the power of modern AM broadcast transmitters. This reduces considerably adjacent station interference, and also simplifies alignment, which consists of peaking the three trimmers at the high frequency end of the band.

Although these sets are unorthodox and somewhat daunting, this and the previous article should help those who may be contemplating restoring these sets, but up until now have been a little deterred by the unconventional layout. ❖

PHILIPS 2510: Component values

Capacitors

C1	5uF
C2	4uF
C3,5,6	1uF
C4	2uF
C7	550pF
C8	1650pF
C9	40pF
C11-15	0.5uF
C16,17	13pF
C18-20	0.5uF
C27	(4pF)

Resistors

R1,5	50k
R2	200k (100k)
R3,6	40k
R4,8	38k (30k)
R7,9	2M
R10	30k
R11,14	100k
R12	20k
R13	35 ohms
R15	200 ohms
R16	100 ohms
R17,18	50 ohms
R19	225 ohms
R20	40k
R21	50k (100k)

Valves

V1	E442
V2	E442
V3	E415 or E424
V4	V443
V5	506

Note: Values in brackets are for 1931 models. Some sets do not have C14 or C20.

50 and 25 years ago...

'Electronics Australia' is one of the longest running technical publications in the world. We started as 'Wireless Weekly' in August 1922 and became 'Radio and Hobbies in Australia' in April 1939. The title was changed to 'Radio, Television and Hobbies' in February 1955 and finally, to 'Electronics Australia' in April 1965. Here we feature some items from past issues.

October 1947

Colour TV for Theatres: Colour television pictures on a 7-1/2 x 10 foot theatre screen were shown publicly for the first time by Radio Corporation of America in a demonstration of its all-electronic colour TV system at the Franklin Institute in Philadelphia on April 30. Colour motion pictures, films and slides were projected with utmost realism.

Dr V.K. Zworykin, who demonstrated the new system to illustrate his address on 'All Electronic Color Television', says that the large-screen system employs the all-electronic simultaneous method of colour television developed at RCA Laboratories, Princeton NJ. In the simultaneous colour process, Dr Zworykin explained, three separate images in red, green and blue are transmitted at the same instant over adjoining television channels of the same bandwidth as used in standard television.

Then at the all-electronic receiver, the three colour signals are applied to picture tubes with coloured phosphor faces. The flickerless pictures on the face of each kinescope are projected by an optical system to the auditorium screen, where they are superimposed in perfect registration to form a single image.

October 1972

Domestic Communications by Satellite? The Hughes Aircraft Company of Los Angeles has sold communications satellites worth over $50 million to Canada and to the Western Union Telegraph Company in the USA. A Hughes representative was in Australia in August to discuss local communications needs with relevant agencies and major users.

The Canadian system, which will be the first domestic satellite communications system in the Western world, is designed to solve many of the same problems that exist in Australia, due to the vast distances between outback settlements. Mr R.D. Brandes said in Sydney that the system could bring 'studio quality' television and telephone services to isolated areas anywhere in Australia or New Guinea.

Such a system for Australia, Mr Brandes said, would cost about $70 million. The Canadians have contracted with Hughes for three satellites for $30 million; two to be launched and one to be kept in reserve in case of a launch failure. They will also pay $14 million to have NASA launch the satellites.

Laser 'death ray' near: The US Department of Defense's spending on high energy lasers is expected to rise dramatically as researchers discover how to build CW lasers in the 100kW class. Continuous outputs over 200kW have been already reported, and if power can be increased as much as 100:1, laser weapons will be a reality. ❖

EA CROSSWORD

ACROSS

1 Big unit of information. (8)
5 French inventor of tubular lighting. (6)
10 Imprecise. (7)
11 Two wires wound together as one. (7)
12 Attachment. (4)
13 Electromagnetic induction unit named after an American physicist. (5)
14 Outdated unit of length. (4)
17 Take a photograph. (5)
18 Dispose from craft. (8)
21 Science and practice of reaction propulsion. (8)
23 Pastime. (5)
27 Number of 'bars' in this grid? (4)
28 Activate card reading. (5)
29 Shape of certain type of speaker. (4)
32 Form of an element. (7)
33 Pioneer of electrical stimulus. (7)
34 Name associated with space telescope. (6)
35 Trade name of a web browser. (8)

SOLUTION TO SEPTEMBER 1997:

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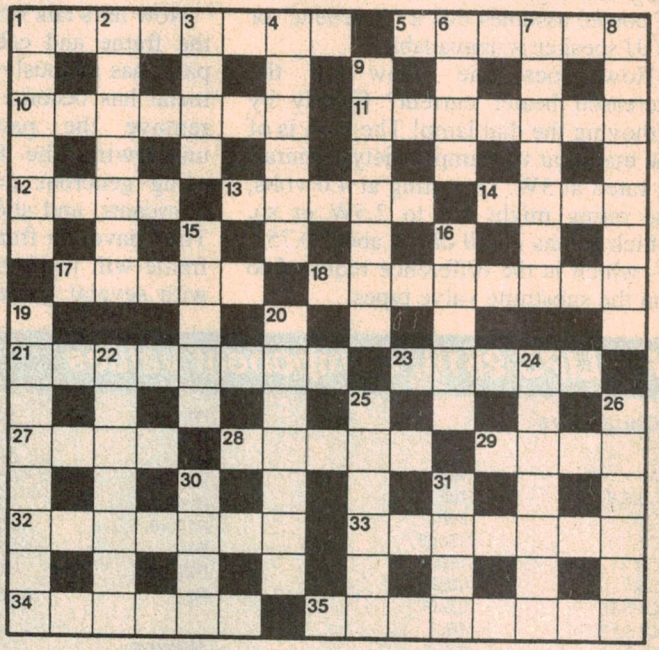
DOWN

1 Minor fault. (6)
2 Having shades of black and white. (7)
3 Concentrated radiation. (4)
4 Cable linking two objects. (6)
6 Useful period for battery, etc. (4)
7 Communications to satellites. (7)
8 Private listening device. (8)
9 Terminated a mission, project, etc. (7)
15 Donor of famous prize. (5)
16 Laboratory seat. (5)
19 Name of a Queensland university. (8)
20 Word appearing in one of these clues. (7)
22 Electrical unit. (7)
24 Personal information. (7)
25 Point in an orbit. (6)
26 Contrivance. (6)
30 TV picture fault. (4)
31 Sign shows polarity. (4) ❖



Electronics Australia's

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TEXAN FIRM DEVELOPS A 'PACEMAKER FOR THE BRAIN' TO CONTROL EPILEPSY

REVIEW OF DRAGON'S NEW 'NATURALLYSPEAKING' VOICE RECOGNITION PACKAGE

HANDS-ON TEST REPORTS: THE METEX FOUR-IN-ONE 'UNIVERSAL INSTRUMENT', JAYTECH'S LOW COST 35MHZ DUAL CHANNEL OSCILLOSCOPE

HEWLETT-PACKARD'S NEW HP 34970A LOW COST SYSTEM FOR DATA ACQUISITION: 22-BIT RESOLUTION, BUILT-IN SIGNAL CONDITIONING FOR THERMOCOUPLES, RTD'S & THERMISTORS, SCANNING OF UP TO 250 CHANNELS/SECOND AND STORAGE FOR 50,000 READINGS... *(See page 120)*

NEWS HIGHLIGHTS

SONY, PHILIPS BREAK FROM DVD ALLIANCE

Sony, Philips and Hewlett-Packard have announced a decision to break away from the 10-member DVD Forum. The firms want to promote their own DVD format, which will allow consumers to both play back and record multimedia data.

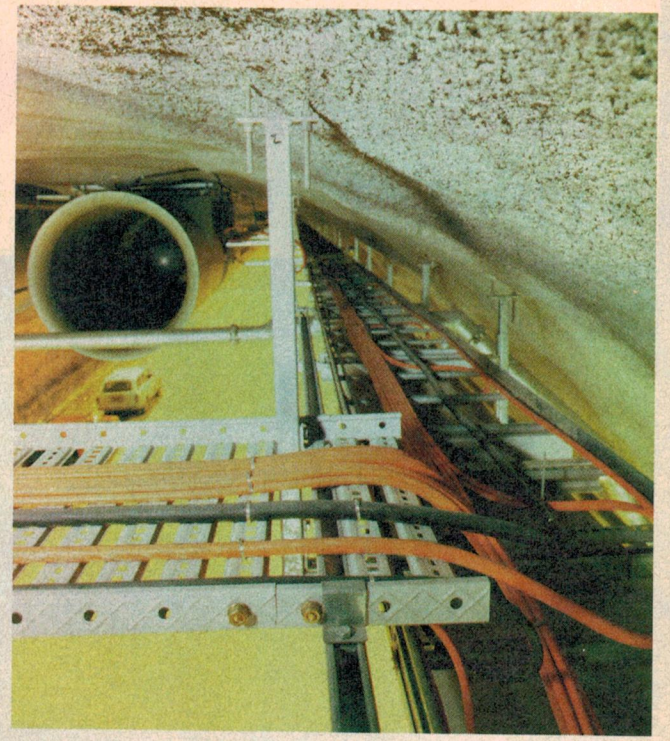
The Sony-inspired move has sparked fears of a new VHS-Beta type battle, in which consumers will be asked to choose sides. The last time around, in the 1970s, Sony and Philips lost the fight. This time, however, the companies believe their DVD format is too superior to the existing DVD standard for consumers to ignore.

In particular the ability to speed machines to market that will allow for recording as well as playback, will mean a huge boost for the Sony-led DVD effort. What's more, the Sony format will still allow consumers to use their playback disks bought for the current generation of DVD machines.

Sony also said it will continue to manufacture DVD playback-only machines using the current standard. But newer machines with recording features will operate under Sony technology. "We are simply following our policy of developing new technology, and the optical discs are no exception", a spokesman for Sony said.

Sony's move deals a severe blow to the DVD Forum, which includes major rivals such as Toshiba and Matsushita. Sony's new DVD disks are the same size as current disks but contain 15% more storage capacity.

Industry analysts said the DVD Forum was in deep trouble long before this split-up. In April, for example, Sony, Philips and Pioneer Electronic started licensing DVD patents to other manufacturers, ignoring the DVD Forum plan to offer licences only as a group.



The new M2 motorway in Sydney's northwest involves a long tunnel, in which huge exhaust fans are used to maintain air quality. The cables used to monitor and control the air system were supplied by MM Cables, and are rated to withstand 1000 degrees for two hours.

PROSTHESIS FOR EPILEPSY CONTROL

The US Food & Drug Administration (FDA) has given approval to Texas-based Cyberonics Inc., to market its proprietary, implantable vagus nerve stimulation device, the NeuroCybernetic Prosthesis (NCP) System, for the treatment of medically refractory partial onset seizures. The clearance came less than 180 days from the time that Cyberonics submitted clinical trial data from seven studies to the FDA and less than 20 days after the FDA Advisory panel unanimously recommended approval of the product.

The NCP System, a 'pacemaker for the brain', is the first device treatment option ever made available for epilepsy. The implantable device consists of a generator and a nerve stimulator electrode which transmits anti-epileptic electrical signals to the brain through the vagus nerve in the neck. The device is indicated by the FDA for use 'as an adjunctive treatment for adults and adolescents over 12 years of age with medically refractory partial onset seizures'.

Epilepsy is the world's second most prevalent neurological disorder, affecting an estimated 50 million people worldwide. The disorder is characterized by intermittent disturbances in the normal electrical functions of the brain, known as seizures. Manifestations of a seizure include interruption or complete cessation of movement, generalized contraction of the body, decreased responsiveness, loss of awareness of surroundings and complete loss of consciousness.

"This is the future of epilepsy treatment for hundreds of thousands of people who have not found relief from seizures using existing therapies", said Dr Douglas Labar, MD, PhD, of Cornell University's Comprehensive Epilepsy Center. "Many epilepsy patients will be able to enjoy a higher quality of life, free from the restricting symptoms of this disorder."

The NCP System is a fully implantable device, intended for patients with medically refractory partial onset seizures, that is, those patients who are unable to control seizure occurrence with antiepileptic drug treatment or epilepsy surgery. Implantation of the device is accomplished during a one to two hour surgical procedure, which can be performed on an outpatient basis. Like a pacemaker, the pulse generator is implanted under the skin in the chest. The lead wire is then tunneled under the skin to the lower neck, where it is placed around the vagus nerve. Using an external programmer, the neurologist can set or reset the stimulation parameters of the device.

The system delivers preprogrammed intermittent electrical pulses to the vagus — for example, 30 seconds on, five minutes off — 24 hours a day. Additionally, when a patient senses a seizure coming on, he or she is able to activate the system to deliver an additional dose of stimulation by passing a magnet over the area of the chest where the device resides. Many patients report that they are able to prevent or abort a seizure using the magnet.

The first human implant of the NCP System occurred in 1988. Since then more than 1000 patients in 24 countries have accumulated over 2000 patient years of experience using the NCP System. (Business Wire)

ASTRONOMY MOURNS DR GENE SHOEMAKER

Planetary scientist Dr Eugene ('Gene') Shoemaker, 69, was killed in a two-car accident near Alice Springs, Australia, on the afternoon of July 18. His wife Carolyn Shoemaker suffered broken bones, and was hospitalized.

A geologist by training, Shoemaker is best known for discovering, with his wife Carolyn and colleague David Levy, a comet near Jupiter. Comet Shoemaker-Levy 9 was broken up by tidal forces from Jupiter, and its fragments collided with the planet in July 1994. Together, the Shoemakers have been the leading discoverers of comets this century.

"Gene was one of the most renowned planetary scientists in the world, and a valued member of the NASA family since the earliest days of lunar exploration", said NASA Administrator Daniel S. Goldin. "His work on the history of meteor impacts and the role that they play in the evolution of the Solar System is a fundamental milestone in the history of space science."

ISP SHAKE-OUT LOOMING, SAYS IDC

The Australian Internet Services Provider (ISP) market is set for the kind of shake-up that overtook the PC market a few years ago, according to recent IDC research. And with the discussion broadening over how to best implement the Internet, the focus is shifting from simply providing connection to offering value-add.

"The Internet service provider market is entering an era of consolidation and greater competition. With the market being so top and bottom heavy, there is set to be a shake-out, and many ISPs are going to have to make changes if they are to survive or prosper in the future", said Tim Sheedy, IDC Australia's Internet/Intranet analyst.

The ISPs also seem to see it that way and, on average, value-added services are set to rise from 20.3% of total revenues to almost 50% in 2001. "They're right to be looking for revenue sources beyond pure connection", said Sheedy. According to the newly-released IDC report *The Australian Internet Service Provider Market: Review and Forecast, 1996-2001*, the much-touted rise of the Internet is on and there's money to be made — and lost. In fact, the number of ISPs has risen more than threefold — from 120 to over 400 — while the average revenue per subscriber has dropped from $280 in 1995 to $220 in 1997.

Based on a survey of ISPs across Australia, the IDC report also provides a demographic breakdown, analysis of the services on offer and the technologies being used as well as discussing a range of issues affecting the dynamic and fast-growing Internet market. Further information is available from IDC Australia, 3/76 Berry Street, North Sydney 2060.

LOW POWER MMX PENTIUM FOR LAPTOPS

Intel Corporation has unveiled new low power 233MHz and 200MHz Pentium processors with MMX technology, for use in mobile PCs. The new processors with MMX technology are the first products built on Intel's advanced 0.25 micron manufacturing process, which enables greater than 40% reduction in power consumption for the same processor performance.

"Intel's continued commitment to advancing the mobile PC platform is demonstrated by the first implementation of the 0.25 micron manufacturing process to the new 200 and 233MHz mobile Pentium processors with MMX technology", said David Bolt, General Manager of Intel Australia. "Utilising this advanced lithography process brings unprecedented speed and low power consumption to the mobile PC, which results in better battery life for notebook users."

In addition to a larger 32KB on-chip cache and other architectural enhancements that improve the processor's performance when running existing software applications such as office suites, MMX technology also enables fast Internet communications and provides high-quality graphics, video and sound.

SYDNEY'S 'TECHNOCITY'

TechnoCity, opening soon at Capitol Square in the Haymarket, is claimed to be Sydney's first retail centre dedicated solely to 'digital shopping'. Already a strong marketing campaign is under way to bring the top information technology providers on site.

"TechnoCity is an exciting retail concept which will give customers from both the private and business sector the opportunity to survey in one place the very latest information technology — both software and hardware", said Mr Wing Liu, Development Executive of First Scope Developments. "Those in the business of information technology may now display their products in a totally digital-friendly environment", he added.

The digital shopping centre is in fact a

All new TV receivers sold in the USA must be fitted with the so-called V-Chip, to allow parents to control which programs can be seen by their children. Los Angeles firm Soundview Technologies has produced this V-Chip Converter box to provide the same facilities with the 200 million older sets. (Business Wire)

series (almost a maze) of glass-walled modules (kiosks) of different shapes and sizes, serviced by a fibre-optic cable grid.

"The flexible module design of TechnoCity has advantages for both shoppers and retailers", said Richard Archer, design architect. "Shoppers are permitted maximum access to products and interactive services, while retailers will require little expenditure on fitout and may simply plug their services into the TechnoCity cable grid." The fibre-optic grid or 'backbone' servicing each retail module has been installed by North Communications.

TechnoCity also features a 50-seat lecture theatre with multiple uses including video-conferencing, multimedia events, training classes or other functions.

Firms which have already signed on at TechnoCity include Microconcept, Thinking Head (multi-media and web site developers), Software for You (video games, concepts), Information Technology and Westan (NSW).

LOSS OF ADEOS SCIENCE SATELLITE

On June 30 the National Space Development Agency of Japan (NASDA) declared its ADEOS Advanced Earth Observing Satellite lost, after only nine months of operation. Two NASA instruments were aboard the satellite, a Total Ozone Mapping Spectrometer (TOMS) and the NASA Scatterometer (NSCAT), which was providing data on sea-surface winds.

The loss of the ADEOS satellite will have a particularly serious impact on oceanographic research since two instruments, the Ocean Colour and Temperature Sensor and the Polarization and Directionality of the Earth's Reflectance Sensor — both capable of providing routine global estimates of phytoplankton pigment concentrations, were also lost.

NASA is cooperating with NASDA to identify the cause of the ADEOS failure and recommend a solution for future missions.

INMARSAT-3 F4 ENTERS SERVICE

The fourth satellite in the Inmarsat-3 series, one of the world's most advanced communications spacecraft, entered service on schedule on Saturday, July 26 at 06.00 GMT, completing the third generation Inmarsat system.

With the activation of the new satellite, Inmarsat's commercial maritime, aeronautical and land mobile communications systems have gained from increased capacity. The new satellite has also brought virtually global coverage for Inmarsat's new lightweight portable satellite phone.

Inmarsat-3 F4, launched aboard an Ariane 4 rocket from Kourou, French Guiana, has replaced Inmarsat's previous generation Atlantic Ocean West region satellite, now a system backup.

"F4 completes the Inmarsat-3 constellation, which will help to shape a new era of global mobile satellite communications," said Eugene Jilg, executive vice president of Inmarsat.

The spacecraft is located at 54° West.

FIRST IRIDIUM LINKS OPERATING

The first satellite-to-ground mobile paging and radio communications links via the Iridium system have been established by Motorola, making them the first such transmissions to be conducted by a low-earth orbit, mobile satellite communications system.

On July 3, an Iridium satellite transmitted hundreds of messages to Iridium prototype pagers during a South-to-North orbital pass over Motorola's Satellite Communications Group (SCG) facility in Chandler, Arizona. The first links between the satellite and Iridium prototype phone handsets were made July 7.

"These first communications links with Iridium satellites represent major technical milestones toward commercial activation of the system in late 1998," said Mark Borota, vice president and general manager for SCG's Mobile Satellite Systems Division. SCG is the developer of the Iridium system.

The satellite-to-ground links originated from an Iridium satellite launched on May 5. The satellite transmitted programmed, alphanumeric messages to the prototype pagers. The pagers are being designed by Motorola's Messaging Systems Products Group.

The signals transmitted to the prototype phones were ring channel burst signals that will enable Iridium subscriber handsets to locate and acquire a satellite, to initiate and receive voice, data and fax messages. Iridium handsets will look for a ring channel burst every time they are activated. The handsets are part of a portfolio of voice subscriber products being developed for use with the Iridium system, by Motorola's Cellular Subscriber Sector (CSS).

US STATION TESTS 480P DIGITAL TV

In efforts to investigate the various potential options for the transmission of

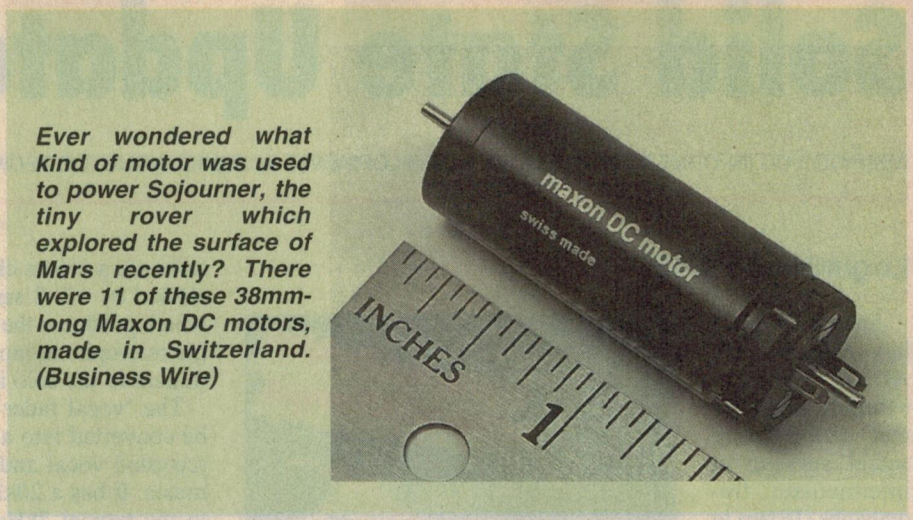
In the USA, Variety's Showbiz Expos draw large numbers of production and post-production people from the film and TV industry. The first Australian version of the event is being held at the Melbourne Exhibition Centre on November 13-15 this year.

digital television, WHD-TV, the US television industry's Model High Definition Television Station has conducted a test terrestrial broadcast of television signals in the 480-line progressive scan digital video format, commonly known as '480p'. The test was performed using Panasonic encoding and decoding equipment.

The 480 progressive format is one of the video formats defined by the Advanced Television Systems Committee (ATSC) Digital Television Standard. Other formats include the higher resolution 1080-line interlaced or '1080i' video format, which is normally broadcast by WHD-TV. The new Panasonic equipment expands the experimental station's complement of real, working hardware available to demonstrate the breadth and flexibility of the nation's new digital broadcasting system. In advance of the FCC's deadline for the start of digital TV broadcasts, US broadcasters are considering which video formats best suit their needs.

The model HDTV station is housed within the facilities of WRCTV, an NBC-owned and operated station that serves the Washington, DC area. According to Project Director Jim McKinney, WHD-TV has two primary goals. "We want to promote the rapid implementation of digital advanced television systems for all video formats defined by the ATSC", Mr McKinney said. "We also want to educate broadcasters on how they can implement digital TV." WHD-TV has been on the air every business day since June 30, 1996.

The Panasonic equipment which made the test broadcast possible included a 480p encoder that was co-developed with Texas Instruments-Japan, a subsidiary of Texas Instruments, and a 480p decoder that Panasonic developed on its own. The encoder progressively scans images with 704 x 480 pixels at a 59.94Hz frame rate, in 16:9 aspect ratio using MPEG 2 compression.



Ever wondered what kind of motor was used to power Sojourner, the tiny rover which explored the surface of Mars recently? There were 11 of these 38mm-long Maxon DC motors, made in Switzerland. (Business Wire)

AUST FIRM TO CHALLENGE HOLLYWOOD

A wholly-owned Australian post-production company is set to challenge Hollywood's biggest studios and special effects houses using the latest in film technology, from Digital Equipment.

Dedicated Digital Rendering (DDR) aims to capture a significant share of the international and domestic markets for rendering — the transformation of computer generated images into film, TV, multimedia images or games. The company has made a multi-million dollar investment in Digital's Alpha based computers and Softimage software, and has established a world-class rendering facility in Melbourne, the largest of its kind in the southern hemisphere.

This new industry has also resulted in the creation of 25 new jobs at DDR, which is the first company of its kind in Australia to opt for this 64-bit solution since Digital introduced it to the computer animation and entertainment industry in March this year.

"For a production company such as DDR which is running the latest in rendering applications, this new AlphaServer solution will enable them to produce exciting creative, dramatically reduce production time and stay on budget," said Stephen Kendrick, Systems Product Marketing Manager for Digital Equipment Corporation (Australia).

Computer-generated animation has formed the basis of mega-hit movies such as *Toy Story* and *The Lost World*, and rendering is a key element in the success of transforming this imagery into the world of film.

NATIONAL EXPANDS SANTA CLARA FAB

National Semiconductor Corporation is investing US$100 million to expand its 8-inch wafer facility in Santa Clara, California. The expansion will add 100 jobs.

The investment adds 1400m² of Class 1 cleanroom space to National's Advanced Technology Group (ATG) wafer lab. The ATG facility, currently 2300m², serves as National's research and development fab where the company develops, evaluates and tests the latest manufacturing processes and tools. As these processes and tools are perfected, they are replicated and transferred to National's state-of-the-art, commercial production fab in South Portland, Maine.

Circuitry etched on the silicon wafers at ATG will begin at 0.35-micron with the ability to migrate to 0.25- and 0.18-micron geometries.

"Expanding this facility is consistent with National's goal to put systems on a chip for our key trendsetting data highway partners", said Kamal Aggarwal, National's executive vice president of manufacturing. "We'll now have more room to pilot the latest equipment and processes, to drive higher levels of integration and functionality on a chip."

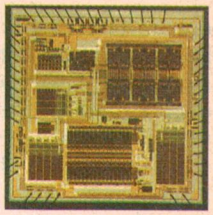
Jobs created by the expansion include engineers, technicians and fab operators. ❖

NEWS BRIEFS

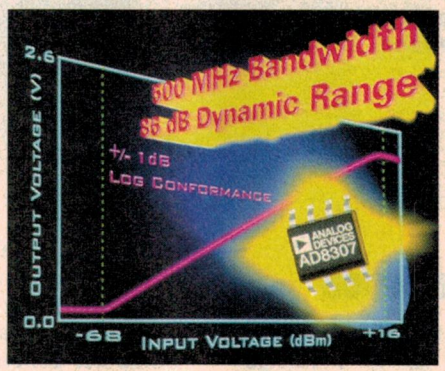
- The Westin Stamford and Westin Plaza in Singapore is hosting ***EMC ASIA 1997***, the first international exhibition and convention with workshops on electromagnetic compatibility. Dates are November 4 to 6, 1997. Details on http://www.mesago.de.
- The annual conference of The Australian and New Zealand Solar Energy Society ***Solar'97*** will be held in Canberra, from 1st to 3rd December 1997. For more information contact Solar'97, PO Box 1402, Dee Why 2099; phone (02) 9311 0003.
- ***Java@Work***, a conference showcasing the latest in Java tools and technologies will be held between September 10 and 11 at the Sydney Convention Centre. For more information contact Softbank Forums on (02) 9211 7467.❖

Solid State Update

KEEPING YOU INFORMED ON THE LATEST DEVELOPMENTS IN SEMICONDUCTOR TECHNOLOGY...



Logarithmic amp



Analog Devices has released the AD8307, a logarithmic amplifier that can measure signal strength at intermediate frequencies (IF) up to 500MHz. A log amp is a key building block in a wide range of radio-frequency (RF) applications/systems. Most RF systems require two mix-down stages, one to the IF and one to baseband. This new device eliminates the need to mix down to baseband.

The device can determine the power level (in volts) of an extremely wide dynamic range input signal and is a useful component for circuits measuring received signal strength (RSSI) and/or transmitted radiated power (TSSI). It is therefore well suited for communications, low-cost radar and sonar signal processing.

The device is based on a progressive compression technique where each of the cascaded gain cells provides a small-signal gain of 14dB with a 900MHz bandwidth. The combined stages result in a dynamic range extending from -68dBm (approximately 89uV from a 50Ω source) to +18dBm (1.77V). Over this range, the logarithmic conformance is typically less than +/-1dB from DC to 300MHz, and +/-2dB at 500MHz. Because there is no intrinsic minimum frequency limit, the IC can be used at or below audio frequencies. It operates from a single supply of 2.7 to 5.5 volts and draws 8mA of current.

For further information circle 280 on the reader service coupon or contact Analog Devices, PO Box 98, West Rosebud 3940.

Digital karaoke IC

Medianix Semiconductor has introduced the second generation of its single-chip digital audio processors for bringing enhanced karaoke features to consumer audio products. The new MED25102 is claimed to be the only karaoke IC to incorporate an 'auto multiplex' feature, accept two microphone inputs, and offer 90dB of signal-to-noise ratio (SNR) performance without needing any digital signal processor (DSP) programming by the user.

Based on the Medianix 16-bit DSP core, the device is an application-specific digital audio processor that has firmware in the on-chip ROM and contains all interface circuits needed to add karaoke to any audio system. Target applications are video-CD (V-CD) players, audio-visual (AN) sound systems and other consumer products needing karaoke capability.

The 'auto multiplex' function helps a singer keep pace with the lyrics by mixing in a variable amount of pre-recorded vocal when the live singing stops. As soon as live singing resumes, the pre-recorded singing is muted. Other unique features are a 'voice changer' which allows a singer's voice to be shifted by +7/-8 semitones, and 'microphone vocal harmony' which produces the sound of two vocalists by processing a single microphone input to create a pitch-shifted vocal accompaniment to the solo input.

The 'vocal fader' feature allows any pre-recorded audio to be converted into a karaoke music track by removing the pre-recorded vocal and then superimposing a live vocal over the music. It has a 20kHz microphone input bandwidth compared to the typical 7kHz bandwidth. Evaluation kits are available for the device.

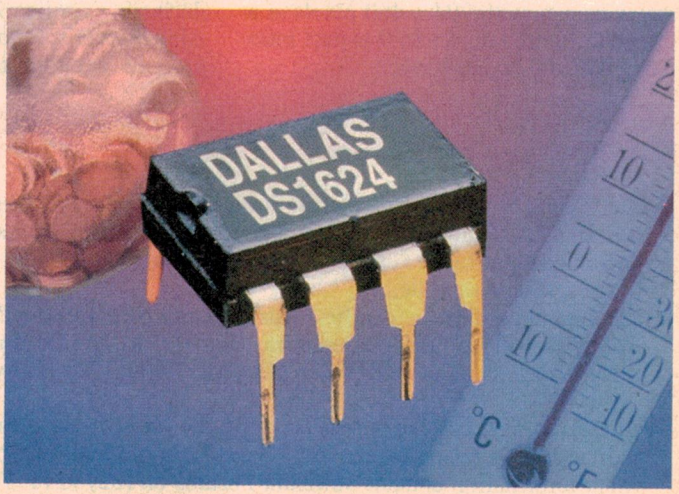
For further information circle 272 on the reader service coupon or contact Medianix Semiconductor Inc, 100 View Street, Suite 101 Mountain View, CA 94041; phone (415) 960 7081, fax (415) 960 0478. (Web site **www.medianix.com**)

Digital thermometer with cal EEPROM

The DS1624 digital thermometer from Dallas Semiconductor is claimed to be the first digital temperature sensor to feature 256 bytes of EEPROM on-chip to store temperature related compensation information. According to the company: 'Although the on-chip, non-volatile memory can store any information, its primary application is crystal compensation, as the EEPROM can store how the crystal's frequency changes over temperature.'

The device is also claimed to have the highest resolution for a digital thermometer, and outputs temperature directly as a 13-bit 2's-complement word. It measures temperature from -55 to +125°C in 0.03125°C steps. Thermometer accuracy is 0.5°C across the 0 - 70°C range.

The DS1624 operates from 2.7 to 5.5 volts and uses two-wire bus architecture featuring three-bit addressability, which allows users to connect up to eight chips to the bus. The sensor is factory calibrated and converts temperature directly, eliminating the need for an A/D converter. It suits any application that requires thermal compensation, such as temperature-compensated crystal oscillators in cellular phones, test equipment or radio systems.



For further information circle 271 on the reader service coupon or contact Dallas Semiconductor, 4401 S. Beltwood Parkway, Dallas, TX 75244-3292; phone +(972) 371 4448 (URL **http://www.dalsemi.com**).

Extra high brightness LEDs

Hewlett-Packard has announced a line of 5mm aluminium-indium-gallium phosphide (AlInGaP) light-emitting diodes, said to have the highest intensity of any LED lamps currently in production. Applications include traffic-management designs, such as traffic signals and variable-message signs, and in commercial outdoor advertising, such as moving message signs.

HP claims to be the only LED manufacturer to guarantee the brightness stability of its high intensity AlInGaP LEDs, which use an advanced optical-grade epoxy that ensures brightness stability and reliable operation over a wide range of temperatures and moisture conditions. The package's epoxy also contains ultraviolet inhibitors to reduce the effects of long-term exposure to sunlight.

The special lens structure enables precise control of light output to ensure that letters and symbols in message panels appear consistently sharp and bright over the viewing angle. Three viewing angles are available, and the LEDs come in three colours: amber (592nm wavelength), reddish-orange (617nm) and red (630nm). Each version is available with standoff tabs on the leadframes to make automated assembly easier.

For further information circle 273 on the reader service coupon or contact Hewlett-Packard Asia Pacific Ltd, 17-21/F Shell Tower, Times Square, 1 Matheson Street, Causeway Bay, Hong Kong; phone +(852) 2599 7777. (Web site **http://www.hp.com/HP-COMP/led_lamps**)

CMOS op-amps in tiny packages

Burr-Brown's new 0PA336 series of MicroPower CMOS operational amplifiers are designed for battery powered applications and operate from a single supply down to 2.1V. They are claimed to feature the lowest offset voltage (125uV max) of any non-chopper CMOS op-amp on the market, and provide a rail-to-rail output within 3mV of the supplies with a 100kΩ load. The op-amps take a 20uA quiescent current, and feature a 1pA bias current and an open-loop gain of 115dB.

The 0PA336, 0PA2336, and 0PA4336 are available in S0T-23-5 (single), MSOP-8 (dual), and SSOP-16 (quad) packages. These devices have identical specifications that apply over the full specified operating range (Vs = 2.3V to 5.5V). The dual and quad designs feature completely independent circuitry for lowest crosstalk and freedom from interaction.

For further information circle 274 on the reader service coupon or contact Kenelec, 2 Apollo Court, Blackburn 3130.

Stereo audio D/A converter

Burr-Brown's new SoundPLUS PCM1723 is a stereo audio D/A converter that includes an oversampling

digital interpolation filter, delta-sigma modulator, analog low-pass filter, and an analog output amplifier. The device is capable of eight-times oversampling at sampling frequencies up to 96kHz. It can accept 16, 20, or 24-bit input data in either normal or I²S formats and includes special features such as soft mute, digital attenuation, digital de-emphasis, and selectable output formats. The IC suits applications which combine compressed audio and video data, such as DVD players, DVD-ROM drives, set-top boxes, and MPEG sound cards.

The converter features a unique on-board programmable phase-locked loop (PLL) which generates the digital audio master system clock from the 27MHz MPEG clock. The PLL frequency can be programmed for sampling at standard digital audio frequencies, as well as one-half and double sampling frequencies. Specifications include: 94dB dynamic range, 256fs or 384fs system clock, single +5V power supply, sampling frequencies up to 96kHz, and left, right, mono, mute output modes.

For further information circle 279 on the reader service coupon or contact Kenelec, 2 Apollo Court, Blackburn 3130.

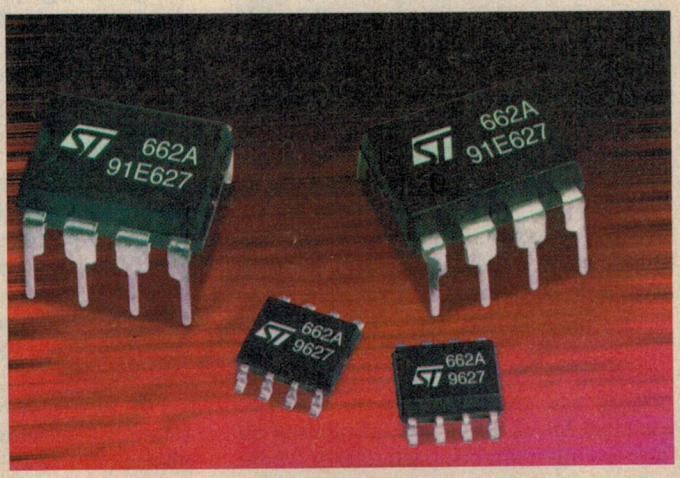
DC-DC converter for flash memory

SGS-Thomson has introduced a compact 5V to 12V DC-DC converter IC for generating the programming voltage required by industry standard dual voltage flash memories. Known as the ST662A, the device provides a stable 12V +/-5% output from a 5V +/-10% input, and doesn't need an external inductor.

The IC can supply 30mA of output current to drive the Vpp pin of Flash memory, with an input voltage as low as 4.75V. The device has a quiescent current of 100uA, which is reduced to 1uA via a shutdown pin that can be controlled by a microprocessor.

The device is supported by an application demo board for evaluation. The printed circuit layout of the demo board can be copied directly or incorporated into a customer application board.

For further information circle 276 on the reader service coupon or contact SGS-Thomson Microelectronics, Suite 3, Level 7, 43 Bridge Street Hurstville 2220. ❖

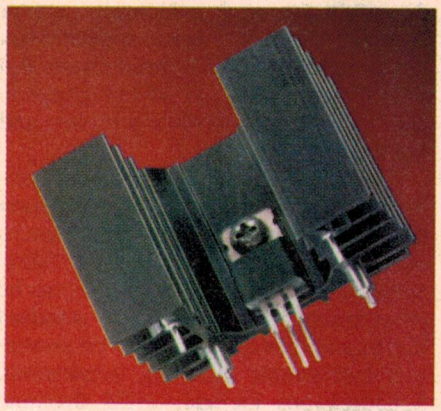


NEW PRODUCTS

Regulator heatsink for 233MHz Pentium

Aavid Thermal Technologies has announced the 5820 series heatsink for a TO-220 voltage regulator that supports the new Intel Pentium 233MHz microprocessor. It allows existing motherboard designs to be used as there's no additional space taken by the new heatsink and CPU. It incorporates a built-in thermal interface pad and predrilled mounting holes for attachment to the TO-220 regulator.

The heatsink has a peak rating of 15.4W, and an anodised finish for



maximum heat dissipation for use in natural convection cooling. Tests confirm it maintains the heat of the regulator well below its maximum specified case and junction temperatures with no significant airflow around it.

For further information circle 243 on the reader service coupon or contact Aavid Thermal Technologies P/L, 126 Tagore Lane, Singapore 787553; phone +65 452 8827. (Web site **http://www.aavid.com**)

Contact cleaner and treatment oils

A new contact cleaner oil (CCO) and a contact treatment oil (CTO) are now available from Richard Foot. The CCO is a blend of non-CFC solvents and RF's contact treatment oil. The product is claimed to have exceptional penetrating and cleaning properties and to be ideal for cleaning and lubricating all non-arcing contacts, particularly where previously used oil and greases have dried out. It is safe on most plastics.

The contact treatment oil is a synthetic oil with a wide temperature range and low evaporation loss, said to loosen tarnish caused by oxidisation. It also allows hardened oil and greases to be easily removed. It is claimed to improve electrical performance by increasing contact area, preventing arcing, reducing 'hot spots' and providing mechanical lubrication to reduce wear in all electrical assemblies. It is suitable for all switches, relay contacts, potentiometers, connectors, plugs and sockets. It is also an effective mechanical oil for long life, high temperature lubrication.

For further information circle 244 on the reader service coupon or contact Richard Foot Pty Ltd, 14/2 Apollo Street, Warriewood 2102; phone (02) 9979 8311.

PCB mount 90° panel receptacle

The DBPC 102 multi-way receptacle series from W.W. Fischer with two to seven contacts is now available with 90° formed pre-wired contacts for soldering to PC boards and mounting to panels. The pre-aligned contact wires ease assembly for dip and flow solder.

An optional clamp provides rigid fix-

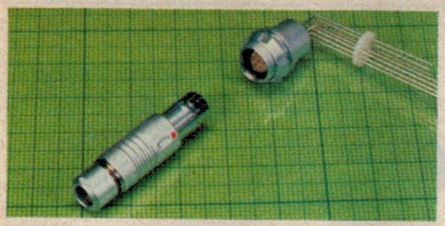
450 to 477.5MHz handheld transceiver

The new Pantech PS-400CW 16 channel 5W portable transceiver from Imark Communications operates in the Australian UHF high band from 450MHz to 477.5MHz. It comes with multi-tone digital coded squelch and multi-tone CTCSS encode/decode, selectable on a per-channel basis. Features such as transmit time-out timer, time-out timer penalty, busy channel lockout, delayed Tx, low battery alarm and battery saver circuit are standard inclusions.

Numerous features can be programmed, including channel frequency, CTCSS or DCS encode or decode on a per-channel/per-mode basis, transmit time limiter to prevent channel jamming, penalty time period to delay access to the repeater after 'timing out', and Tx delay to eliminate squelch tail noise when using CTCSS tones. The transceiver can be field programmable with an IBM compatible computer.

The compact transceiver is ruggedly constructed and has a high selectivity front end which provides a switching bandwidth of 10MHz on the UHF high-band. Two RF power outputs of one or five watts are selectable on the top panel. It is powered by a nickel metal hydride battery and the radio section is sealed with O-rings to resist dust and moisture. The antenna is attached by a stud type connector, and the user controls and knobs are on the top of the radio. A miniature six-way QC connector is provided for the optional speaker/microphone.

For further information circle 242 on the reader service coupon or contact Imark Communications P/L, Unit 2, 75 Mark Street, North Melbourne 3051; phone (03) 9329 5433.



ing of the receptacle to the board, and allows continuity of the ground. This clamp can support a smaller circuit board or adjust the board to the panel. The receptacles feature the same secure push-pull self-locking system as other devices in the series, and can be used with all standard and sealed plugs in the series.

For further information circle 245 on the reader service coupon or contact W.W. Fischer Ltd, Connecteurs Electriques, CH-1143 Apples, Switzerland; phone (+41) 21 800 3711, fax (+41) 21 800 3924.

Low force socket adaptors

Advanced Interconnections has released its new Pop-Top ultra-low extraction BGA socket adaptor systems. The Pop-Top system allows assemblies to be plugged and unplugged through a limited insertion stroke design that protects devices and fragile solder joints by reducing extraction force.

The design features limited insertion depth terminals. The terminals are held securely in position by a patented screw-down heatsink/retention clamp on the top of the assembly, preventing the terminals from fully penetrating the socket contacts. The heatsink gives thermal connection to the device and the lower lip of the clip can be used to separate the adaptor from the socket. The BGA device is soldered to the adaptor.

For further information circle 246 on the reader service coupon or contact Ampex Technologies, 4 Wetherill Street, Silverwater 2128; phone (02) 9648 4488. (Web site **http://www.ampec.com.au**)

Mobile 50W HF SSB transceiver

Q-Mac Electronics has released the HF-90 Manpack, a package that combines the Q-Mac HF-90 HF SSB transceiver, a compact tuner, collapsible whip antenna, rugged SLA battery system and a military grade canvas backpack. The complete pack with all accessories weighs around 6.5kg and suits a variety of military/paramilitary and commercial applications.

The Manpack is designed for mobile applications that require medium to long range communications. The system can be deployed instantly and used while being carried, or when staked into the ground. The HF-90 transceiver has a maximum power output of 50W PEP, which is downward adjustable, and has capacity for up to 255 programmable channels. In conjunction with the manpack antenna system it has a frequency coverage from 3.6 to 10.3MHz, with optional operation down to 2.7MHz. With alternative antennas it has a coverage from 2.0 - 30MHz.

The transceiver is housed in a ribbed aluminium extrusion and can withstand harsh environmental conditions. If servicing is required, the PCBs can be accessed or exchanged quickly and easily.

For further information circle 248 on the reader service coupon or contact Q-Mac Electronics P/L, PO Box 1334, Osborne Park Business Centre, WA 6017; phone (08) 9443 9336. (Web site **http://www.wantree.com.au/~qma.**

Front panel labels by laser

A new way of making aluminium front panel artwork from a laser printer has been released by 3M. The product is a thin A4 size sheet of self-adhesive backed aluminium foil that is printed on as it passes through a laser printer. This lets you develop the front panel artwork on a computer, then print it as if you are printing on paper.

The foil is designed to pass through a laser printer's paper transport mechanism. After printing, the result is durable printed artwork that can then be sprayed with a clear protective lacquer. It provides a simple way of making front panels, etc., from a computer without needing photographic techniques. The sheets are available from Rod Irving Electronics in A4 sizes for $3.95 each (cat H28167), or a pack of 25 sheets for $67.95 (cat H28160).

For further information circle 241 on the reader service coupon, see your local Rod Irving Electronics store, or contact Rod Irving Electronics, Bag 620, Clayton South 3169; phone (03) 9543 7877. ❖

SPOTLIGHT ON

SOFTWARE

Dragon's NaturallySpeaking

Dragon Systems' NaturallySpeaking has recently been released, and its name would suggest it offers computerised speech recognition with the ability to handle continuous unbroken speech. With a vocabulary of over 30,000 words, and the ability to adapt itself to almost any English-speaking user, NaturallySpeaking is certainly going to change the way we work with our desktop PCs.

by GRAHAM CATTLEY

By now, almost everyone will have heard of DragonDictate, one of the first 'real' speech recognition systems developed for the PC. DragonDictate caused quite a stir when it was released back in 1993 and since then we've seen it progress through a number of different versions (for DOS, Windows and Mac), to the version 2.0 for Windows that was released in late 1995. This last version was reviewed by Jim Rowe in our June 1996 issue, and it represented perhaps the ultimate in desktop voice recognition systems at the time.

Well, Dragon Systems certainly haven't been resting on their laurels ever since, and to prove it they've come up with the latest version called 'NaturallySpeaking'. NaturallySpeaking offers many advantages and improvements over DragonDictate, including a larger vocabulary and improved verbal editing commands — but looming over all of these features is NaturallySpeaking's ability to recognise continuous speech.

With the previous versions of DragonDictate, you had to use a tiny-pause-between-each-word mode of speech in order to give the software an indication of where each word started and stopped. With a bit of practice you could get used to this slightly stilted form of speech and get up to a reasonable speed of dictation — but the fact remained that it could only handle one word at a time.

Science Fiction?

With NaturallySpeaking the idea is that you can speak normally, without pausing between words, and the computer will transcribe it all correctly. Now, if you've ever had any experience with computer speech systems you'll know that *true* speech recognition is in the realms of science fiction; continuous arbitrary speech is just too complex to be interpreted by such a formal system as a computer.

NaturallySpeaking (NS) comes awfully close though, as I was to find when reviewing it, and after a bit of setup and training the results are downright impressive.

So what are the limitations? Well, first up you are going to need a halfway decent computer. NS requires a Pentium 133 with 32MB RAM, a soundcard, 60MB of free hard drive space and a CD-ROM drive, and this is just the minimum system required to get it off the ground. Oh, and you'll also need Win95 or NT, as NS doesn't support Windows 3.11. Such a system isn't uncommon these days, but compared with the requirements for the popular DragonDictate, it's quite a jump in the resources needed.

Secondly, NS can only support one user. Once it has been set up and trained for one person, it won't recognise anybody else. And because it seems to use some form of direct file access, you can't simply copy over a new set of speech files.

One other limitation, if you can call it that, is that all the text is entered into an application that is very similar to WordPad. Once the text has been entered, it can then be transferred to the target application via the clipboard using cut, copy and paste commands. This is in contrast to DragonDictate, where you could enter the text directly into the application, such as Word or Excel. The reason for this change is obvious once you start using NS — the system is obviously working flat out analysing your speech, and can't support the extra overhead of a large application as well.

There are advantages in having a specialised application for text entry, and one of the most useful is that you need only remember the one set of editing commands.

With NS, Dragon have dropped the command mode/edit mode system, and you can now edit your document simply by pausing and saying 'undo that' or 'delete previous three words', or even 'select document, copy all to clipboard'.

The voice commands carry over to program functions as well, with menu items selected by commands like 'click File', 'click Open' and 'click OK' letting you tell the computer what to do. At any stage you can say 'What can I say?' which will bring up a voice (and mouse) activated Windows help screen where you can quickly find the information you need.

Trying it out

Dragon NaturallySpeaking comes in a slightly fatter than normal software box, and contains the software on CD-ROM, a getting started booklet and a handy

Dragon NaturallySpeaking Personal Edition

Continuous speech recognition software for the PC. Comes with a noise-canceling microphone headset.

Good points: Performs well, adapts well to the user after a couple of training sessions.

Bad points: Was struggling at times on a Pentium 150 with 32MB — you'll need a fair bit of horsepower to let it run smoothly.

RRP: $699.00.

Available: From Dragon Systems dealers, or enquire from distributor Auscript, Level 4, 60-70 Elizabeth Street, Sydney 2000. Phone (02) 9238 6500, fax (02) 9238 6566.

Dragon's NaturallySpeaking personal edition is shown here with the noise-cancelling microphone headset that is supplied as part of the package. The noise-cancelling circuitry is mounted inside the small black box, along with the batteries.

quick reference card. Also supplied is a small noise-cancelling microphone headset, with the microphone connected via a generous length of lightweight cable to a small plastic box. This box holds the noise-cancelling circuitry along with two AA batteries, and it in turn plugs into the computer's sound card. While there isn't an on/off switch for this external unit, the instruction slip supplied indicated that the batteries should last a couple of months before they would need replacement.

Once a fresh set of batteries was installed, I ran the setup program which proceeded to install the 30MB of program files and 8MB of speech files.

The next stage was to run the audio setup wizard, which calibrates the microphone and monitors the performance of the soundcard. This is an important step, as some soundcards tend to be a bit noisy in their front ends and this can degrade the signal coming in from the microphone. To perform the actual test, the user is asked to read aloud a sample sentence a couple of times, while the system measures the quality of the received signal.

With this setup procedure completed, the system prompts you to run General Training. This step configures NS to recognise your speech patterns by getting you to read aloud for around half an hour while it monitors the way you pronounce each word. I chose an excerpt from Arthur C. Clarke's novel *3001: The Final Odyssey*, which was displayed one paragraph at a time in a small window.

As I read each sentence aloud, the text changed colour from blue to yellow as the system recognised each word, usually three or four words behind me. Occasionally it would trip up on a word, whereupon a large yellow arrow would indicate where it had difficulties in understanding what was said, and I could pick up again from there.

One thing that repeatedly stopped NS in its tracks was my pronunciation of the word 'ask'. I tend to use the long vowl sound which results in something like 'aahsk' instead of the short 'ask' that it was obviously expecting, and this seemed to trip it up every time. Luckily there is a 'skip' button that lets you jump over troublesome words, and with the help of this I was able to get through the piece in around 25 minutes.

Once I had read through the excerpt, NS then had to update its speech files — a process that took over half an hour of constant disk activity, even on my fast (9ms) hard drive.

Of course this setup procedure only needs to be done once, but it was over an hour and a half before I was able to run the actual text entry application.

Hello, computer...

As I said before, this application resembles Win95's WordPad, with the addition of a 'Microphone on/off' button, along with a couple of others.

Faced with a blank work area and flashing cursor, one can get a little self-conscious talking to a computer, and so I decided to try reading aloud the opening paragraph of the Getting Started booklet. As I started speaking, a small yellow ToolTips window popped up under the current line with a string of words that sort of resembled the words that I'd spoken.

As soon as I had finished the sentence, however, I could see the computer sorting through various interpretations of the sounds I had made, and after a couple of seconds the resulting sentence was transferred to the main window. Flushed with success (it had interpreted my paragraph correctly), I started reading from a novel that was close to hand, taking it slowly and checking each sentence as I went.

It wasn't until halfway through the second page that I realised that I had speeded up and was reading aloud at a normal speed, and that the program was interpreting everything I said very well. It was at this point that I realised (despite all the claims in the accompanying literature) that this *really was* true speech recognition. The computer was, through a process of recognition and interpolation, actually able to make sense of the continuous stream of noise I was making. Yes, some of the words *were* wrong, quite a few of them in fact, but on the whole it managed quite well.

There are some useful commands that you can use while dictating, such as saying 'go to sleep', which turns off the microphone so you can handle an interruption, and its matching command 'Wake up', to turn it on again.

One thing I noticed was that NS would consistently misinterpret certain words. Whenever I said 'telephone', for example, It would come up with 'telephone the'. To fix this, I pressed the 'Train Words' button which brought up a small requester window. I could then type in the word and then record the way I pronounced it. I decided to tackle several troublesome words in this way, and this resulted in much improved

recognition of these words. (One word that I couldn't train was 'hobbyist', no matter how many times I went through the training procedure, NS would always interpret the sound as 'hobbyists'. I put this down to bad enunciation on my part however, rather than a failing of the program.)

Better vocabulary

Having explored most of the features of NS, I thought I'd try running the Vocabulary Builder, which builds a working vocabulary based on your previous work. This is done by 'feeding' it text files of past articles, letters and anything else you have, whereupon it will look at the way in which you write, and which words you use. I fed it a collection of about 20 articles that I'd written for EA, and after a few minutes of analysis, it came up with a list of unrecognised words. I selected the words I wanted to add and then spent a short session of reciting the list into the Train Words window.

From that point on, NS changed. Instead of the usual two or three incorrect words per paragraph, it would run for three or four paragraphs at a time without a hitch. And don't forget — this is reading aloud at a normal speed, with normal pronunciation of words (including words like 'and' which tend to come out like 'nn' when you are reading at speed) with no concession made to the computer. (Well, OK, you do have to remember to pronounce each and every punctuation mark, which is easy to forget, as well as saying 'New line' at the end of each paragraph.)

One side effect of the Vocabulary Builder was that it adds new lists of words to the working vocabulary, even if they don't appear in the files you give it. As a result, I found that it was using the word 'pleural' whenever I said 'plural', and entered the word 'colon' when I really wanted a ':'. This sudden propensity for medical terminology no doubt stemmed from the electrocardiogram project article I had given it; this had no doubt triggered NS into including a list of medical words into the system. I have yet to weed these words out of the working vocabulary, but I'm pretty sure that it will be an easy thing to do.

Conclusion

All in all, Dragon Naturally Speaking performs very well. Once you've gone through the Vocabulary Builder (which I feel should be incorporated into the setup routine) the recognition capabilities of the package increase dramatically, resulting in a system that more than lives up to expectations.

In a situation where you are entering standard text into a computer system it would fit the bill nicely, and I would even say that it would compare favourably in terms of speed and accuracy with an OCR system. Once you get use to using it, you find that it is most efficient to use a mixture of voice, mouse and keyboard to perform the function of text entry, selection and editing; but there is no reason why the system couldn't rely on voice alone.

So with the provision that you have a reasonably beefy computer to run it on, Dragon NaturallySpeaking is a friendly, practical system that performs well and will no doubt be of great benefit to many people, especially those who (like the author) never learned to touch type. ❖

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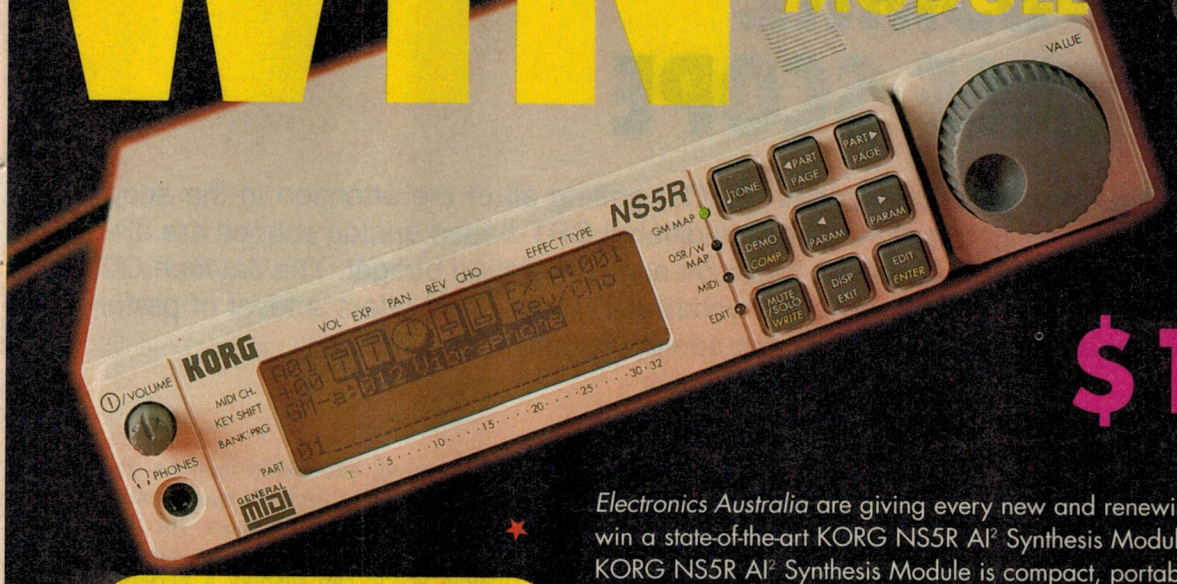

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Test & Measuring Instruments Feature:

JAYTECH 35MHZ DUAL-TRACE SCOPE

With sophisticated digital storage oscilloscopes (DSOs) getting all of the attention in the scope market at the moment, its easy to forget that more traditional CRT-based analog scopes are alive and well, and *still* the most practical option for those on a strictly limited budget. The Jaytech QC-1901 is a good example of this type of low-cost 'workhorse' scope, and offers a level of performance and features that should suit hobbyists and service technicians alike.

by ROB EVANS

It's fairly safe to assume that an oscilloscope can be regarded as the cornerstone piece of test equipment in almost any workshop involved with electronics. Without a scope you can't really 'see' what's going on in a circuit, and once you have the usual array of basic gear — tools, DMM, soldering iron, and say a power supply — the next 'indispensable' piece of gear is likely to be an oscilloscope.

Unfortunately though, a scope tends to cost you far more than the other pieces of basic workshop equipment. So for most of us, the outlay for even a fairly spartan model is substantial. As a result there's a lot of interest in the lower-priced end of the market (say, below $1000) — where there are quite a few analog scopes offering a bandwidth of around 20MHz, dual trace capability, reasonably comprehensive triggering facilities, and a respectable vertical sensitivity.

The Jaytech QC-1901 itself has a rated bandwidth of 35MHz and a nominal input sensitivity range of 5mV to 5V per screen division, which in turn can be increased to 1mV to 1V (via the 'x5' switch) at a reduced bandwidth (10MHz). This performance level seems to be a cut above its nearest rivals in this very competitive end of the scope market, so we'd imagine that the QC-1901 should be very attractive proposition to those who don't need the storage and wider bandwidth capabilities offered by the new breed of *relatively* low-cost DSOs.

Along with a capable level of signal performance, the QC-1901 also offers a healthy range of triggering facilities. Along with the usual trigger features found in this type of scope there's TV vertical (DC — 1kHz) or TV horizontal (1kHz to 100kHz) coupling, a trigger hold-off control (helps you view just one section of a complex wave), and a true *alternate* trigger source mode.

This latter feature is usually not available in lower-priced scopes as it happens, and is very useful when monitoring two signals that are not locked together in the time domain — that is, not synchronised. Note that when the scope is in its normal dual-trace mode, the two waveforms are displayed in an alternate sweep fashion, taking it in turns to use the screen, in effect. The alternate *trigger* function allows each screen sweep to be triggered from its matching channel (one, then two, etc) so that both (unrelated) waveforms can be displayed in a stable fashion — very handy indeed...

These extra features aside, the Jaytech QC-1901 offers pretty much what you would expect from a dual-trace analog scope in the sub-$1000 price bracket; the designers certainly haven't neglected any of the usual functions in favour of a few frills. Also, the scope's controls and front panel layout are quite sensibly arranged, which helps to make driving the QC-1901 quite an intuitive process — we instinctively reached for the correct control knob or switch almost every time.

We ran though a number of basic performance tests in the lab during our test drive period, and found that the scope matched the supplied specifications with relative ease. Perhaps the more important aspect however is just how well a scope can display a variety of waveforms, and here again, the QC-1901 turned in a creditable performance in terms of trigger stability, screen brightness and clarity, and so on.

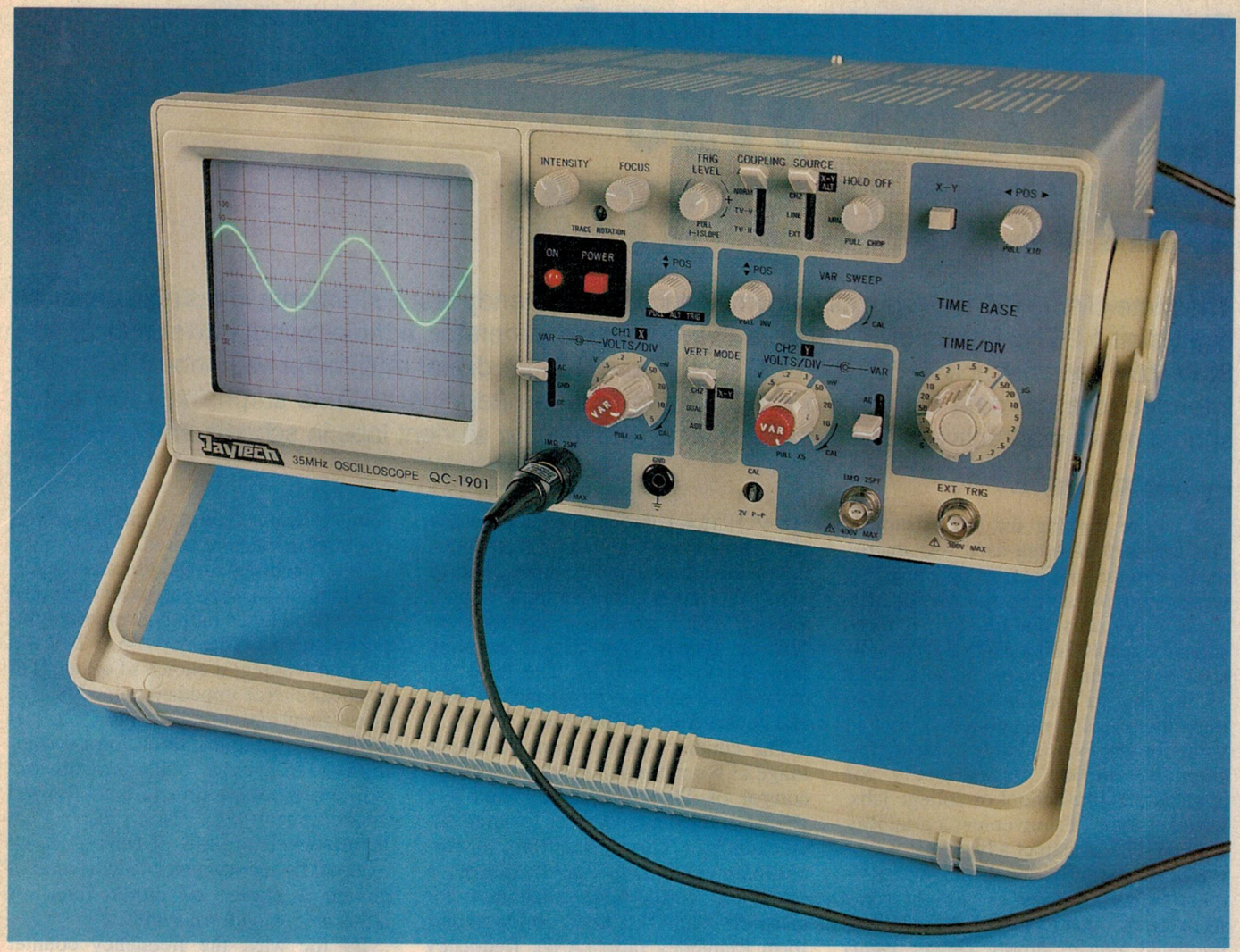
Of course as with all analog scopes of this type, the triggering couldn't really cope with complex non-repetitive signals, and the apparent screen brightness dropped considerably at high horizontal sweep speeds. This is familiar territory for most scope users, and it's really just a matter of using a degree of interpretation with complex signals, and simply cranking up the brightness control when dealing with frequencies near the upper end of the scope's range.

The QC-1901 has both a particularly sharp display and a great deal of brightness in reserve, by the way, and may well be ahead of its competitors in this regard.

From a mechanical point of view the Jaytech scope seems well constructed and features a very rigid all-metal chassis with vinyl-clad steel covers. As you might expect, we couldn't resist the chance to take a look inside, and found

Basic Specification

Screen	150mm diagonal, 8 x 10 div graticule
Bandwidth	DC — 35MHz (-3dB)
Sensitivity	5mV — 5V plus x5 gain switch
Input impedance	1M ohm/25pF
Max input voltage	400V (DC + AC)
Sweep Speed	0.1us/div — 2.0s/div (1-2-5 sequence)
Trigger sensitivity	approx 1V internal, 1.5V external
Power consumption	38W
Weight	7.6kg



that its circuitry was contained on just three main (single-sided) circuit boards, plus two small sub-boards — one for the CRT gun connections, and the other for the timebase switch assembly. Again, the internals seemed well put together, and should easily stand the inevitable knocks and bangs of a workshop environment.

With external dimensions of 324 x 398 x 132mm, the QC-1901 is clearly more compact than similar scopes produced in the past (we have quite a few of these in the *EA* lab), which is probably a testament to just how much this traditional design has been refined over the years. The compactness appears to be mainly due to increased efficiency in the power supply design, as this part of the circuit (including the power transformer) takes up very little space inside the QC-1901's case. Note that the circuit boards contain fairly conventional components, with no sign of surface-mount devices or dedicated LSI chips. So it should be easy to service, if that's ever needed...

As a further indication of this compact format, the scope weighs in at only 7.6kg (much less than older models), and has a typical power consumption of just 38 watts. So in short, the basic format may be familiar, but current manufacturers (in this case from Taiwan) really seem to have honed this design to a fine edge.

We were pleased to see that the Jaytech QC-1901 is supplied with a full schematic diagram (wow!), and an A4 format 39-page operation manual. The latter is quite comprehensive and features detailed descriptions of all controls, a generous smattering of diagrams, plus a number of helpful setup examples for making common measurements.

Not surprisingly perhaps, the manual *also* features sections of dubious spelling and oddball expressions through the text, but this doesn't hinder the content to a significant degree. The manual referred to a 'SLOP switch' for example, whereas we could only find a SLOPE switch on the unit itself!

Other than that, two standard 1.4m x1/x10 scope probes are included with the Jaytech QC-1901. While these seem of a decent quality, we did find that one probe exhibited a poor frequency response during our bench tests. This could not be corrected with the built-in calibration trimmer, and we assume that it's just a (hopefully isolated) case of a manufacturing defect...

At an all-up price of $799 then, the Jaytech QC-1901 appears to represent a very creditable balance between performance, features and cost for a scope at this 'affordable' end of the market. It performed very well indeed, and should be quite suitable for both professional and home use. You can check one out for yourself at your nearest Jaycar store. ❖

Jaytech QC-1901 scope

A low-cost 'entry-level' 35MHz dual-trace analog oscilloscope for hobbyists and service technicians.

Good points: Easy to use with a good range of features, comprehensive documentation.

Bad points: Considering the price, none really.

RRP: $799 (including two probes).

Available: Jaycar stores around Australia.

Test & Measuring Instruments Feature:

METEX MS-9150 UNIVERSAL SYSTEM

The Metex MS-9150 is essentially a combination of four handy test instruments in a single case: an eight-digit 1.3GHz frequency counter, a 2MHz function generator, a triple-output power supply with 85W total capacity and 3-1/2 digit LCD meter, and a 3-3/4 digital multimeter with inbuilt RS-232C interface to allow data logging via a PC. These features (together with its surprisingly low price) should make it attractive for development labs, and also for student labs in schools and colleges.

by JIM ROWE

If you're looking for an instrument that crams four often-used test instruments into the smallest possible size and weight, for portability, the Metex MS-9150 is probably not for you; it measures a sizeable 380 x 370 x 185mm (W x D x H), and weighs in at a hefty 13.5kg. But on the other hand if you're more interested in rugged reliability and value for money, it's likely to be of considerable interest — especially for applications like school or college labs, where a lack of convenient portability may well be a distinct advantage.

Not surprisingly, much of the instrument's significant size and weight stems from the fact that its inbuilt triple-output regulated power supply (lower right) has a total rating of 85 watts (plus whatever is needed for running the other instruments, of course). This is made up by a fixed-5V output rated at 2A, another fixed-15V output rated at 1A and a variable 0 - 30V output rated at 2A. To provide this order of performance coupled with reliability, the MS-9150 uses a hefty power transformer and some husky linear regulator devices mounted on a large finned heatsink, which takes up about 2/3 of the case rear panel.

To allow convenient adjustment and monitoring of the power supply's 0 - 30V output, it's provided with an inbuilt backlit 3-1/2 digit LCD meter. This displays either output voltage or current, as determined by a pushbutton switch. Multi-turn rotary controls allow both the voltage and current limiting to be set easily, and a LED indicates whenever the supply enters 'CC' (constant current) mode. The two fixed-output supplies have no metering or controls, but all three outputs have main terminals with the standard 19mm spacing to allow full connection flexibility.

The universal counter section of the MS-9150 (top left) has an eight-digit display using seven-segment LED readouts. It provides three input channels, two of which (A and B) have an input impedance of 1MΩ and cover signals from 5Hz to 100MHz, or period counting from 0.1 to 10 seconds. The third 'C' channel has an input impedance of 50Ω and covers from 100MHz to 1.3GHz.

The counter offers a comprehensive range of functions and modes, under the control of 11 pushbuttons. There's a choice of three gating times for frequency counting (100ms, 1s or 10s), for resolution/measurement rate flexibility; a selectable 20dB input attenuator for channels A and B; and the ability to perform frequency ratio (A/B), frequency difference (A-B), frequency sum (A+B), period (A or B), time interval (A to B) and totalising (A or B) measurements.

In frequency measurement modes three auxiliary LEDs at the right-hand end of the display indicate the measurement units (MHz, kHz or Hz), while at the left-hand end another set of LEDs indicate the active channel and the gating time. An additional LED indicates the resolution in period mode, while another provides overflow indication.

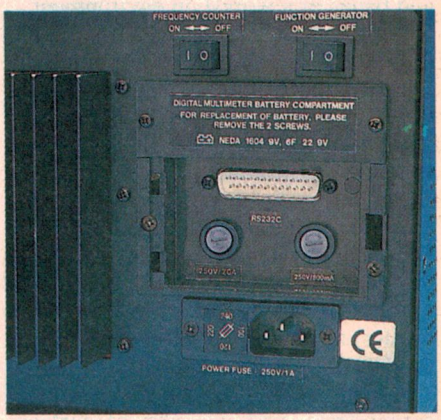
The function generator section of the instrument (lower left) is fairly standard, with a basic frequency range of 0.02Hz - 2MHz in seven ranges. It can produce symmetrical sine, square or triangle waveforms, and also asymmetrical versions of these (i.e., skewed sine, ramp or pulse waveforms) by adjusting the symmetry). There's also a TTL output for logic testing, scope triggering etc.

The generator's frequency is controlled using a set of seven decade-range pushbuttons, plus a rotary control for vernier adjustment within the decades. Setting the output to an exact frequency is also made easy by a built-in link to the counter, which you can enable with a pushbutton when required.

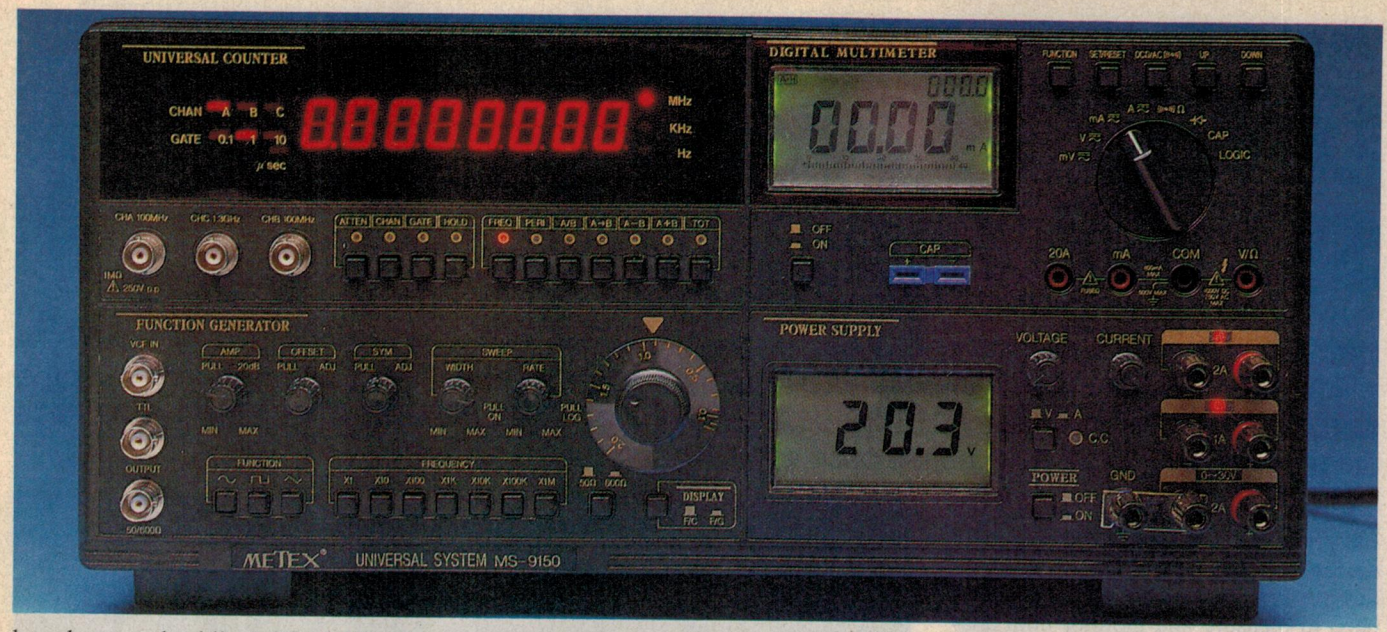
Other facilities on the function generator include a rotary output level control plus a fixed 20dB output attenuator, giving a range from 200mV p-p to 20V p-p with no loading; a choice of either 50Ω or 600Ω source impedances; a choice of either fixed zero or adjustable DC offset (+/-10V); the ability to perform sweeping with an internal oscillator, with control of both sweep time (20ms - 2s) and width (up to 100:1). There's also a VCF input socket to allow sweeping via an external frequency control signal, and of course a choice of either fixed or adjustable waveform symmetry.

By the way, the frequency counter and function generator sections of the MS-9150 can be turned off independently when not required, via switches on the rear panel.

The fourth instrument inside the unit is the DMM (top right), which provides a full range of measurement facilities



A closeup of the rear of the MS-9150, showing the DMM's serial port and battery compartment. The switches at top allow the counter and function generator to be turned off when not required.



based on a backlit LCD 3-3/4 digit (3999 count) display with both a supplementary analog 'bar graph' display and a secondary digital readout. There's the standard range of modes: DC and AC voltage (400mV FSR to 1000V DC, 750V AC in five ranges), DC and AC current (40mA to 20A FSR, in three ranges), resistance (400Ω to 40MΩ FSR in six ranges) and capacitance (4nF to 400uF FSR, six ranges), plus continuity/diode test, and logic level indication.

The DMM is basically autoranging, but 'UP' and 'DOWN' pushbuttons allow manual over-ride when desired. You can also configure the meter for maximum or minimum reading storage, data hold and relative offset measurements, and there's the ability to store and recall up to 10 measurements.

The DMM isn't actually powered from the MS-9150's main power supply, unlike the other three instruments. Instead it has its own power switch and runs from a 216-type 9V alkaline battery, which fits in a compartment at the back of the case. This allows it to be fully isolated, and able to make 'floating' measurements on either external equipment or the other instruments in the MS-9150 itself.

Another important feature of the DMM section is that it has a built-in RS-232C serial interface, to allow its measurement data to be conveniently fed back to a PC for data logging or other CAE applications. The serial interface is via a standard DB25 connector on the rear panel. A serial cable and disk with DOS/Windows software for facilitating PC operation are available as an optional extra.

So that's the basic idea of the Metex MS-9150: a combination of four frequently-needed bench instruments in a single sturdy package. But probably the best news of all is that you get this four-in-one package for the price of only $650 ex tax, or about $793 including tax. That's really quite impressive, because you'd pay considerably more for the equivalent separate instruments...

How it performs

We were able to try out a sample MS-9150, courtesy of Australian distributor Macservice. This allowed us to put each of the instruments through its paces, to get a good feel for the overall performance. Frankly we were quite impressed.

The regulation and ripple performance of the various power supply outputs was comfortably within the specs, and should be fine in each case for the vast majority of likely applications. The same applies for the frequency counter, where the sensitivity on each channel was again comfortably within spec, and the timebase accuracy (checked against our TV-derived Reference) was better than 2×10^{-6}.

The function generator proved to be very easy to set up and use. Its frequency setting dial was not overly accurate, but where accurate frequency setting is needed this can easily be achieved using the frequency counter. The waveform purity seemed to be within spec, but we did notice that enabling and adjusting the symmetry control generally causes a fairly drastic change to the output frequency. Not a serious drawback once you're aware of it, perhaps, but it does need to be borne in mind.

The DMM performance again proved to be within spec on all of the ranges we checked, with the basic DCV accuracy actually better than 0.1%.

The review unit came complete with the optional RS-232C serial cable and DOS/Windows software, so we loaded the software into a PC and tried out this option. The software proved to be easy to install and use, and there were no problems in both displaying the DMM readings on the PC monitor (in large, easily read numerals) and also setting it up for simple data logging tasks.

While we had the instrument we also slipped off the cover and had a look inside, to check its build quality. It certainly seemed to be well designed and built, and likely to deliver many years of reliable operation. About the only minor criticism we could make is that some of the front panel markings for the power supply outputs are a little hard to read.

On the whole, though, the Metex MS-9150 'Universal System' four-in-one instrument seems a solidly made unit and a good performer. Considering its excellent value for money at the price quoted, it should be of considerable interest to those looking for a convenient and cost effective combination of these four frequently-used instruments. ❖

Metex MS-9150 Universal System

A combination of three-output 85W regulated bench power supply, eight digit 1.3GHz frequency counter, 2MHz function generator and 3-3/4 digit DMM.

Good points: Combines four handy bench instruments into a single rugged unit; should be especially suitable for labs in schools and colleges. All four instruments provide a good practical level of performance. Excellent value for money.

Bad Points: Nothing major. Front panel labels for power supply outputs could be easier to read; the function generator's symmetry control alters the output frequency quite significantly when it's used.

Price: $650 plus tax (22%) where applicable.

Available: Macservice Pty Ltd, 20 Fulton Street, Oakleigh South 3167. Phone (03) 9562 9500, fax (03) 9562 9590 or email **macserv@ozramp.net.au**.

Test & Measuring Instruments Feature:

LOW COST DAQ SYSTEM FROM HP

Hewlett-Packard has announced a new Data Acquisition/Switch Instrument, the HP 34970A, which delivers high performance and flexibility at a surprisingly low price. Housed in a case the size of the company's existing HP 34401A DMM, the new unit provides 20 channels of 6.5-digit measurement capability for a base price of less than $1900.

HP's new 34970A Data Acquisition Instrument has been specifically designed to meet the needs of research, design and production engineers who need to measure and monitor both analog and digital signals — often on a large scale — but can't justify the costs traditionally required to do this flexibly and accurately. The new instrument offers increased flexibility at an industry-leading price point: 20 channels of 6.5-digit (22 bit) measurements for a base price of A$1869. The compact and portable instrument forms the heart of a modular and reconfigurable DAQ system, using a range of matching low cost plug-in I/O and switching modules, which interfaces readily with a PC and is easily configured. It also provides powerful data logging facilities.

"Our research shows that our customers' biggest frustration with data acquisition is gaining confidence in their measurements", said Scott Stever, project manager for HP's Electronic Measurements Division. "The HP 34970A delivers excellent resolution, accuracy and noise performance at a breakthrough price point."

The unit's modular design enables configuration as a data acquisition system, data logger or high-performance switching and signal-routing solution. This flexibility enables research and design engineers working on product characterizations, and production engineers building automated test systems, to access the features and functionality of a high-end unit at an affordable price.

The HP 34970A offers 11 built-in measurements, with internal signal conditioning. This, coupled with its intuitive user interface, makes it fast to configure and easy to use. Per-channel configurability allows users to set scale factors, alarm limits and measurement functions independently, even on adjacent channels.

The unit operates as a stand-alone instrument, with 50,000 readings of non-volatile memory. However it also comes with Benchlink Data Logger software (Microsoft Windows 3.1, '95 and NT compatible), which enables the user to configure, display, analyze and archive data on a personal computer.

For automated-test and benchtop-automation applications, the HP 34970A provides a flexible, modular design with three slots and a choice of eight add-in switch and control modules for easy customization. The modules include 20-channel and 16-channel input multiplexers, both with built-in cold junction references; a 40-channel multiplexer, also with built-in cold junction reference; dual four-channel RF multiplexer/switchers, of both 50-ohm and 75-ohm impedance (1GHz bandwidth); a 20-channel actuator/GP switch; a 4 x 8 switching matrix; and a multifunction module with two 8-bit digital I/O ports, two 16-bit analog outputs and a 28-bit event counter.

Australian prices for the plug-in modules range from $428 to $717.

At the heart of the HP 34970A is the industry-leading HP 34401A digital multimeter, offering 6.5-digit (22 bit) performance with 0.004% basic DC voltage accuracy and a fast scan rate — as many as 250 channels per second. Software drivers are available to support HP VEE and National Instrument's Labview.

The HP 34970A may also be ordered without the internal digital multimeter, to provide what HP believes is the best 20-channel switching value on the market today.

Information about the HP 34970A can be found on the World Wide Web at **http://www.hp.com/info/bidaq4**. Further information about HP's test and measurement products is also available by contacting HP Australia's Call Centre on 1800 629485. ❖

Test & Measuring Instruments Feature:

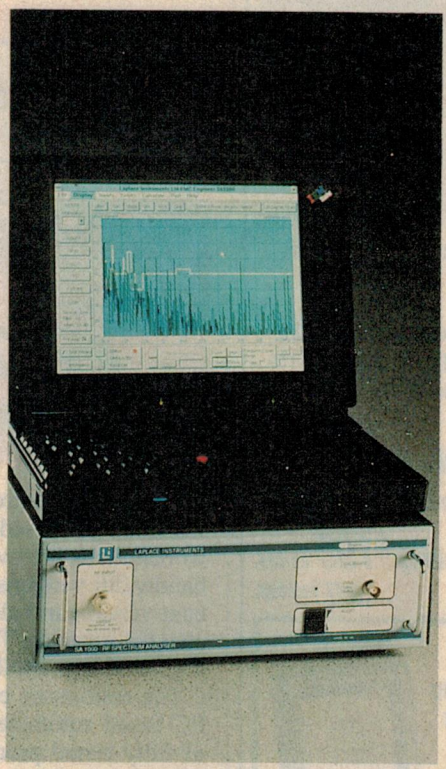
SOME OF THE LATEST INSTRUMENTS

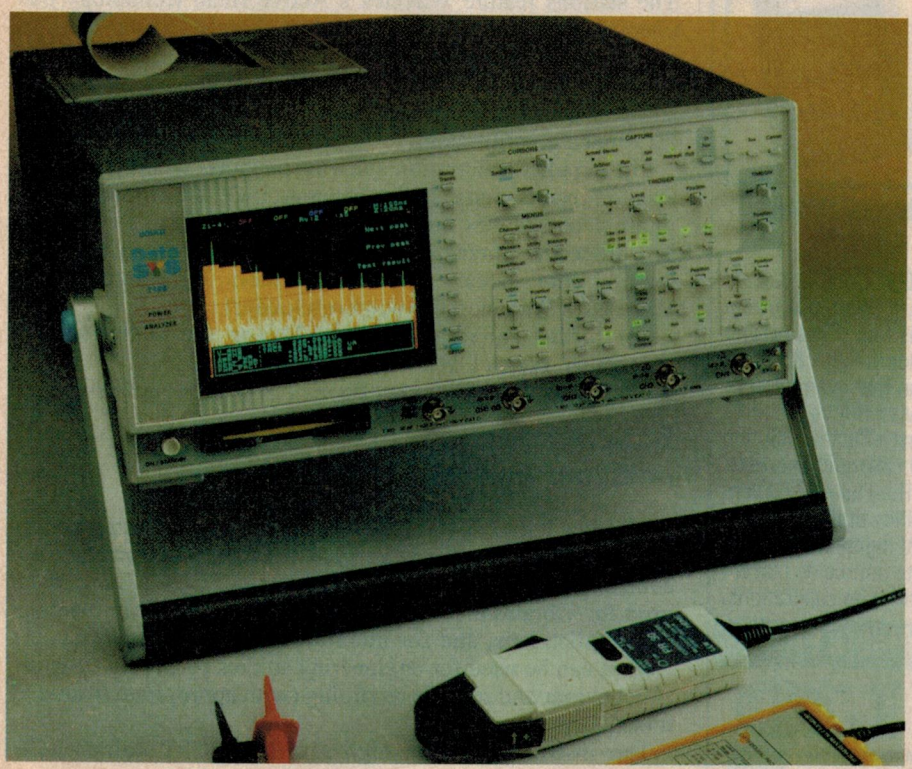
Current harmonic analyser plus DSO

The Gould DataSYS 7100 power analyser combines the functions of a harmonic analyser, power factor meter and digital storage oscilloscope into one compact, portable unit. The instrument is claimed to provide all the pre-compliance measurement capabilities to enable the design of a power supply to meet the current harmonic requirements of EN61000-3-2 (IEC1000-3-2).

The DataSYS 7100 provides live visual information of current harmonics, voltage, current, power and power factor. On-screen current harmonics are displayed against the standard limit line, for real-time visual verification of harmonic performance. The instrument is also a four channel 200MHz digital storage oscilloscope.

For further information circle 203 on the reader service coupon or contact Scientific Devices Australia, PO Box 163, Oakleigh MDC 3166; phone (03) 9579 3622.





1GHz spectrum analyser for EMC

The new Laplace SA1000 1GHz spectrum analyser can be controlled by any PC running under Windows and is suitable for in-house EMC testing. Frequency coverage is from 20kHz to 1.1GHz and complete freedom to select start and stop frequencies is provided, with either logarithmic or linear scaling.

The SA1000's single frequency mode permits true averaging and quasi-peak measurements which can be plotted against time to enable the monitoring of trends and excursions as required by EMC standards for fluctuating emissions. The software package (EMC Engineer) also provides other important capabilities including antenna factor compensation, background nulling, multiple trace comparison and limit line display for common EMC standards.

The analyser can operate with field strengths to less than 17dBuV/m (when used with the Laplace broadband antenna). An in-built calibration source confirms the operation and accuracy of the analyser. An audio modulator and internal loudspeaker facilitate auditory identification of signals. The demodulation technique is suitable for both FM and AM signals.

For further information circle 207 on the reader service coupon or contact Nilsen Technologies, 150 Oxford Street, Collingwood 3066; phone (03) 9419 9999, freecall 1800 623 350.

Digital pressure gauge

The new Accupro DPG-700 digital pressure gauge from Rochester Instrument Systems is a lightweight hand-held calibrator that simultaneously measures and displays pressure and DC milliamp industrial process signals. It is housed in a rugged case and has a sealed membrane keypad for use in harsh industrial environments.

The DPG-700 has a large five-digit display and can be used to calibrate a pressure transmitter. It can show pressure in a wide range of units including inches of mercury, kPa, mBar, inches of water etc. The instrument can be cali-

brated using a precision pressure source and a special keypad sequence. No potentiometer adjustments are needed. It also has a zero key to select the reference pressure, with readings either side of the reference shown relative to zero. It can operate from batteries or an external power source.

For further information circle 205 on the reader service coupon or contact MTL Instruments P/L, PO Box 1441, Canning Vale 6155; phone (09) 455 2994.

Scope calibrators

Wavetek has introduced a family of oscilloscope calibration workstations based on its Model 9500 Calibrator. The new workstations are available in 400MHz, 600MHz and 1.1GHz bandwidth versions. The instruments can be upgraded to the next version and also from single channel plus trigger to five channel versions. They can automatically calibrate analog and digital storage oscilloscopes.

The calibrators come with the latest version of Wavetek's PC-based automated calibration software, including a library of fully tested procedures for commonly used oscilloscopes. The stations feature Wavetek's Active Head technology that couples the calibration waveforms directly to an oscilloscope's BNC input connectors, including levelled sine waves for 3dB bandwidth verification, precision DC levels and square waves for vertical gain calibration, and timing markers for timebase calibration.

The supplied calibration software supports archiving of calibration results, and can also generate ISO9000 compliant calibration certificates and reports, and write new procedures. The procedure libraries can be continuously updated by downloading the latest scope calibration procedures from Wavetek's Web site (**www.wavetek.com**).

For further information circle 201 on the reader service coupon or contact Wavetek Ltd, Hurricane Way, Norwich NR6 6JB, United Kingdom; phone (+44) 1603 404824.

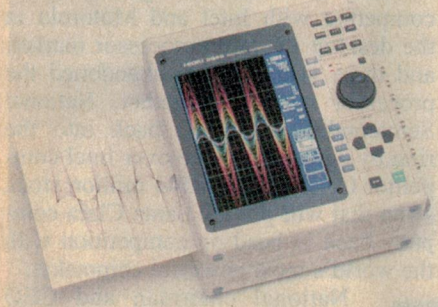
Data recorder-analyser has DAT

The new Hioki 8845 Memory HiCorder can monitor electrical and electronic apparatus, such as circuit breaker auxiliary contacts, switch mode power supplies and PLCs. It can also be used for vibration, stress and strain measurement in machine tool applications, and for monitoring rotating machinery. As well, it can be used for engineering studies involving structural behaviour and seismic recording (with appropriate front-end transducers).

The instrument has a high resolution TFT colour LCD

screen, a large range of display options with numbered and colour coded channel traces and a thermal printer. It has a memory storage capacity up to one megaword/channel and an in-built DAT storage facility. The maximum sampling rate is 200kS/s in memory mode, permitting analysis of signals with frequency components to 100kHz. In direct recording to the DAT drive the maximum sampling rate is 80kS/s, giving years of continuous recording capability.

It is available with digital and analog signal input modules including strain amplifiers for use with pressure, acceleration, displacement and torque transducers. Auxiliary functions include waveform calculations such as FFT, single and dual differentiation and integration, as well as parallel translation along the time axis, peak-to-peak, RMS, rise-time and frequency.



For further information circle 209 on the reader service coupon or contact Nilsen Technologies, 150 Oxford Street, Collingwood 3066; phone (03) 9419 9999, freecall 1800 623 350.

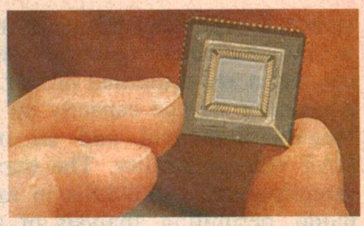
EMC tester is easy to use

The new Schaffner Best 96 is a single package EMC test system for full compliance testing of industrial as well as residential and commercial equipment. It combines in one instrument a multi-function generator providing burst, electromagnetic discharge, surge and power quality pulses (for power line and data line compliance), ground plane, cables, ground strap, grounding resistor and coupling clamp for data line testing.

The instrument has a universal interface/coupler to connect to the product being tested, and pre-programmed tests using built-in test pulses can run a compliance testing procedure with all signal generation functions controlled from a front panel, or from a PC running Windows-based software.

For further information circle 210 on the reader service coupon or contact Westek Industrial Products P/L, Unit 2, 6-10 Maria Street, Laverton North 3026; phone (03) 9369 8802.❖

Silicon Valley NEWSLETTER



New PowerPC chip will run at 350MHz

New PowerPC microprocessors developed by Motorola and IBM will ensure Apple Computer can continue to have performance bragging rights over Intel-based PCs. The new 604e chip will boost Mac performance to 350MHz, while other versions, the 750 and 740, feature clock speeds up to 266MHz.

Motorola product manager Will Swearningen said the 604e chip started shipping in systems in August, and will appeal to developers of servers, multiprocessor systems, and high performance workstations.

Rather than a new chip design, Motorola said the performance boost was generated by implementing a next-generation chip manufacturing process that allowed the company to vastly shrink the size of its top-of-the-line PowerPC processor. The performance of semiconductors increases nearly exponentially when the distances between transistors and interconnects are reduced and electrons have to move shorter distances to accomplish the same tasks.

The fastest 604e chip is priced at US$995 when purchased in quantities of 1000. The fastest 750 and 740 will sell for about $568 and $549, respectively, in similar quantities. Apple Computer showed off a new Power Macintosh at its MacWorld booth based on the 604e processor.

Intel buys C&T for US$422 million

Intel has agreed to acquire Chips & Technologies for US$422 million in cash. The purchase will enable Intel to compete in the market for graphics controllers for notebook PCs, a Chips & Technologies market stronghold. More importantly, the deal will put an Intel label on yet another key component on millions of notebook PC motherboards.

Chips & Technologies, which is located in San Jose, owns a majority of the US$380 million market for notebook graphics controller chips.

Analysts said the acquisition is of particular strategic importance, because Intel is fast losing control over the lower end of the portable market to new competitors such as AMD, Cyrix and IDT. The graphics chips will provide Intel with some new leverage with key customers in this segment.

In the long term, Intel will also be able to gain a significant stake in the graphics controller market for desktop systems. C&T has been developing an advanced new graphics controller IC for this segment in cooperation with Lockheed, under the code name Auburn.

Intel will turn C&T into the new Graphics Components division. Financial analysts said the acquisition also provides Intel with some much needed diversification. The company depends heavily on processors and investors worry that this could leave the company vulnerable to the traditional volatility of the personal computer market.

Engineer Jeniece Pak displays a wafer of ICs with copper metallising instead of the traditional aluminium, made using a new technology developed by US semiconductor industry R&D consortium SEMATECH. The new technology is expected to allow manufacture of higher performance chips...

National's bold plans after buying Cyrix

Nearly a decade after giving up on competing with Intel and Motorola in the desktop PC microprocessor market, and three years after it abandoned the processor market altogether, National Semiconductor jumped back into the ring by agreeing to take over Intel competitor Cyrix in a US$544 million stock swap that will put the Santa Clara company back in head-on competition with the world's most powerful chipmaker.

National chairman and CEO Brian Halla said the Cyrix deal provides the company with the missing piece in its effort to build a single-chip microprocessor for a new generation of sub-$500 network computers (NCs). "Now we'll have all of the building blocks to provide complete system-on-a-chip solutions for sub-$500 PCs and a broad range of low-cost information appliances", Halla said.

Cyrix has a highly regarded high-performance microprocessor, while National produces all of the other vital parts of a PC motherboard, Halla explained. Using the kind of single-chip products National envisions, PC prices could fall as low as US$200. Halla added that the market for PC devices could grow to as many as 700 million units a year from the current 70 million volume.

Cyrix currently has annual sales of around US$200 million, a large portion of which has come from Compaq — which has been purchasing Cyrix chips, in part, to be able to negotiate better prices with Intel. The latter's chips power the bulk of Compaq's computers.

Nine-year old Cyrix has been struggling financially, in large part because it depends on other chip-

makers for the production of its chips. The company has lost money in four of the last six quarters. National had US$2.5 billion in 1996 sales and earned $27 million.

Japanese firms buy more foreign chips

Sales of foreign semiconductors to Japan-based customers reached a record level in the first quarter of 1997, as foreign competitors took a 32.6% share of the vast Japanese chip market.

"The increase in foreign share is a result of vigorous American competitiveness combined with a strong trade agreement on semiconductors between the US and Japan", said George Scalise, president of the US-based Semiconductor Industry Association. Scalise credited the 1996 chip trade agreement for enabling the growth in market share to develop.

Added US Trade Representative Charlene Barshefky, "This is evidence that market forces are at work".

Industry analysts said the problems Japan has been experiencing in the memory market played the biggest role in boosting foreign marketshare. With memory chips selling at less than half their value of the peak in late 1995, the dollar value of Japan's memory market has declined significantly, while the value of the mostly non-memory foreign chips remained steady and demand for those chips has increased.

Boom forecast for car navigation chips

Currently ICs for car navigation systems is a small market, worth about US$200 million in annual revenues. That will grow to US$1.7 billion just in the next four years, according to Dataquest.

Most new navigation systems use a combination of on-board electronics and data storage systems with the global positioning system (GPS), to pinpoint a car's location on a small map shown in a dashboard display. Only 1.1 million of these units were sold in 1996. That will increase rapidly to 11.3 million by 2001, Dataquest has recently forecast.

Along with the circuits that control navigation systems, other electronics sectors will benefit from the growth of this segment, including manufacturers of CD-ROMs and drives, displays, and cellular phones. So far, the most active market for car navigation has been Japan, where chip sales for this segment will reach US$318 million in 1997. Europe is a distant second with US$41 million in sales, and the United States is third with $4 million.

"At the tone, please push 1.8 billion"

Currently each week seems to bring another billion-dollar industry merger involving at least one Silicon Valley company. Now AT&T spin-off Lucent Technologies said it has agreed to pay US$1.8 billion for Octel Communications, a leader in the market for voice mail systems.

The deal will combine Octel's voice mail technology, which works with many types of client systems, with Lucent's strong relationships with many phone companies. Octel also has a strong international market position, serving more than 140 telephone service providers in 70 countries.

Octel founder, chairman and chief executive officer Robert Cohn will be president of the new messaging unit at Lucent.

Octel, based in Milpitas in Silicon Valley, earned US$10.6 million in its third quarter ended in April, on sales of about $150 million. The company was founded in 1982.

Lucent officials said the market for voice, fax and electronic messaging will probably double to around US$10 billion by 2000.

Firms form mobile communications alliance

Seven US and Canadian wireless phone companies, plus chipmaker Intel, have announced the formation of an industry alliance aimed at boosting support for the Global System for Mobile Communications (GSM) standard, covering mobile data as well as voice communications.

The seven personal communications services (PCS) providers said they hope the alliance with Intel will help them boost consumer use of wireless data products and services.

To date, GSM has won few US customers despite the system's popularity in Europe, where GSM is the dominant standard. In the United States, wireless data standards have been slow to develop and remain expensive compared with alternative communication methods.

Members of the GSM Alliance include Aerial Communications, Bell-South's Mobility DCS unit, Microcell Telecommunications, Omnipoint, SBC Communications' Pacific Bell Mobile Services, Powertel and Western Wireless.

Among the digital standards for wireless communications competing in the US to date, GSM has actually been the most successful to date — signing up 646,000 subscribers as of the end of June, versus 420,000 for Code Division Multiple Access (CDMA), the competing standard developed by Qualcomm.

Texas investors acquire Zilog

Silicon Valley chipmaker Zilog is back in Texan hands, after a group of Fort Worth-based investors agreed to put up US$527 million to purchase 93% of Zilog's outstanding shares for $25 apiece. Earlier in its existence, Zilog was owned by Texas oil giant Exxon. The investment group, known as Texas Pacific Group, consists of fewer than 20 people, but includes several wealthy financiers — including the Bass family and David Bonderman.

Zilog was a pioneer in the microprocessor market. The Campbell firm was co-founded by Frederico Faggin, co-inventor of the microprocessor while working at Intel. The company's innovative Z-80 microprocessor lost out in a bid to win the CPU contract for the original IBM PC.

For much of the past decade, Zilog has specialized in logic circuits for specific applications such as television sets and other consumer electronics systems. The company pioneered the concept of application specific standard products (ASSPs).

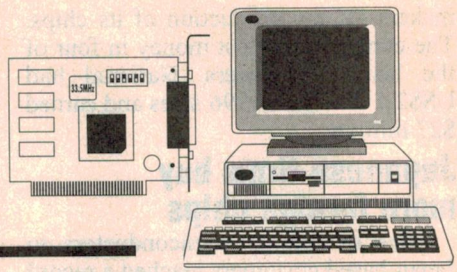
After losing large sums during the late to mid-1980s, Zilog has not experienced a single money-losing month since March 1986. It went public in 1991.

Software message solves secrets case

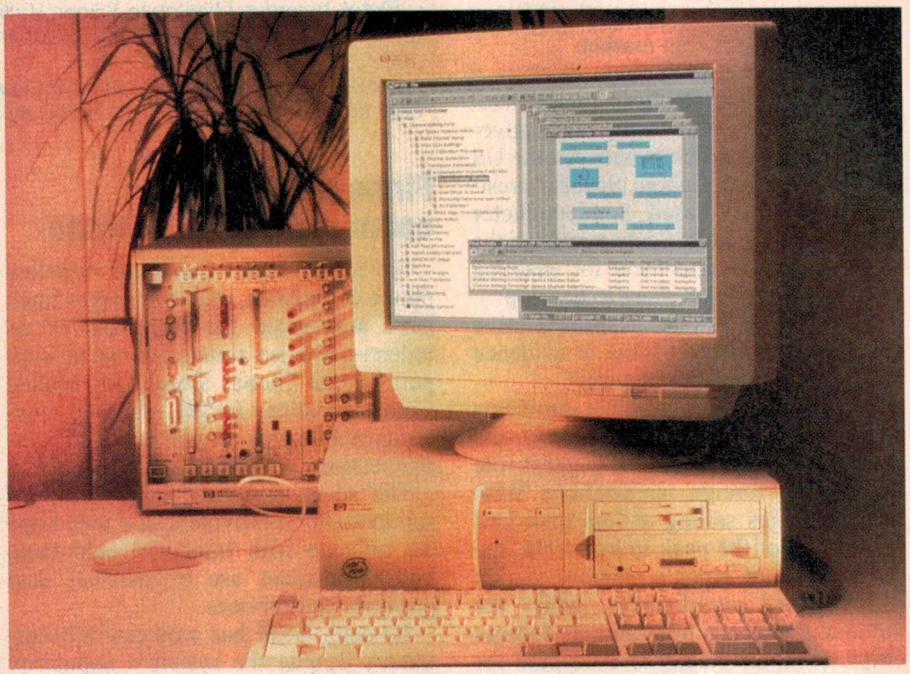
Sun Microsystems has disclosed that a novel technology, originally developed for internal security purposes, helped discover and solve the theft of key semiconductor design software secrets by four former Sun engineers. According to Sun, when the engineers, now employed at digital signal processor design start-up ZSP, used Sun's microprocessor design software to help develop a new product for ZSP, the software sent out an emergency SOS e-mail message to a special server at Sun, which identified who was using the software and where the signal was originating from.

Sun subsequently contacted local authorities, which are now investigating the case. Sun has also filed a lawsuit against ZSP and its four former engineers, charging them with misappropriation of Sun trade secrets, breach of contract, and unfair competition. ❖

Computer News and New Products



Upgrade for visual test prog language



Hewlett-Packard has announced HP VEE 4.0, a major revision of the company's graphical programming language for developing test and measurement applications. The improved performance and new features are said to reduce the time needed to build programs for manufacturing test, design characterisation and verification and data-acquisition applications.

The new compiler encodes HP VEE programs for faster execution. A typical computation-intensive routine will now run 40 times faster than before. A typical test and measurement application, in which execution speed is constrained by input/output performance and instrumentation characteristics, will execute between 150% and 400% faster than applications lacking a compiler feature.

Another new feature is a professional development environment, complete with a new program explorer (similar to Windows Explorer), multiple document interface and debugging capabilities. The graphical user interface (GUI) also provides navigation tools to facilitate managing large programs such as those used to control complex systems that test multiple products.

The instrument manager feature searches for instruments connected to a computer and automatically handles all addressing, including serial, GPIB, VXI, LAN-based and GPIO instruments.

Evaluation copies of HP VEE 4.0 can be downloaded from the Internet at **http://www.hp.com/go/hpvee.com**, along with a variety of application notes, user tips and other technical information.

For further information contact Hewlett-Packard Australia's Call Centre on 1800 629485.

Network computer with digital video

Tektronix has introduced the NC 200 series of business network computers, said to provide full, low cost access to any data — including full-motion video on any host, anywhere on the enterprise network. The new family of intranet desktop computers comes with a local Navio NC Navigator browser and a Java interpreter, and optionally support MPEG-1 digital video and 100Base-T.

The computers are also claimed to be the first network computers to deliver true, full-motion digital video with simultaneous windowed access to the Navigator browser, as well as legacy applications running on major systems including IBM mainframes and DEC minicomputers, open systems applications on workstations/servers, and PC applications through Tektronix' WinDD Software.

The computer family includes logic only units, such as the NC 200 for A$995, and the NC 200H which supports a higher screen resolution, increased expandability, and optional digital video. Systems that include a Tektronix monitor start at A$1595.

For further information circle 163 on the reader service coupon or contact Tektronix, 80 Waterloo Road, North Ryde 2113; phone (02) 9888 0100. (Web site at **www.tek.com\Network_Displays**)

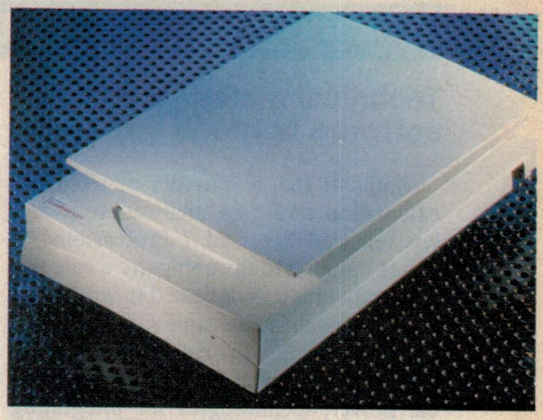
Low cost scanner

Microtek International has released a new range of entry level scanners for the Australian consumer market, including the low cost Scanmaker V300 for home or small office users. Features of the scanner include a choice of two interfaces (SCSI or parallel port) and Microtek's automatic paper detection system, which automatically activates a prescan when the target is placed within the scanning frame.

Included is a scanning and image enhancement driver, ScanWizard, that displays 'before and after' image previews side by side. The batch-scanning feature automatically scans multiple areas of two or more images placed on the scanner bed, and saves them as separate files without external supervision.

Also included is OCR software from Xerox, image editing software from Ulead, a Twain driver and Visioneer Paperport software. The scanner has 24-bit single pass colour scanning with an optical resolution of 600dpi and maximum resolution of 4800dpi. It uses CCD technology and a cold cathode lamp. The RRP is $299 (incl tax).

For further information circle 160 on the reader service coupon or contact Innovision Technology Australia P/L, 260 High Street, Kew 3101; phone (03) 9853 3544 or 1800 813 139.



Low cost 600dpi laser printer

Using a true 600 x 600dpi laser engine, the new QMS DeskLaser 600 is specially designed to run with Microsoft Windows 95 and 3.11 and is capable of producing six pages per minute. It features plug and play support, and uses a unique imaging unit which combines a miniaturised OPC drum and toner, guaranteed to provide optimum print quality. The all-in-one imaging unit cartridge recycles waste toner so spent cartridges don't contain waste toner. A total of 3000 pages can be obtained from one imaging unit. Thanks to the small diameter of the OPC drum, the printer has a very small footprint. RRP of the printer is $495 (ex tax).

For further information circle 162 on the reader service coupon or contact QMS Australia P/L, 30 Atchison Street, St Leonards 2065; phone (02) 9901 3235.

Fast RS-232/485 data converters

Dataforth's new LDM2485AJB series of high speed, RS-232 to RS-485 interface converters are said to turn PCs, terminals and other RS-232 devices into RS-485 workstations. Both models conform to the EIA RS-485 standard.

Operating asynchronously over two or four wires at data rates up to 115.2kb/s, the converters let RS-232 machines 'talk' with up to 50 addressable devices in a multipoint polling environment. Distances of up to 2.4km are possible at lower data rates. They also have 600W silicon avalanche diode surge protection.

Five separate configuration parameters, set with on-board DIP switches, are used to fine tune the converters for demanding multipoint applications.

The LDM2485NB converters draw their power from the RS-232 or EIA-574 data and control signals. The miniature LDM2485A measures 67.5 x 53.3 x 1.5mm and has a DB-25 connector for RS-232 environments. The ultra-miniature LDM2485B measures 63.5 x 26.6 x 19.1mm and has a DB-9 connector for EIA-574. Both models have several options for twisted pair connection.

For further information circle 166 on the reader service coupon or contact Kenelec, 2 Apollo Court, Blackburn 3130; phone (03) 9878 2700.

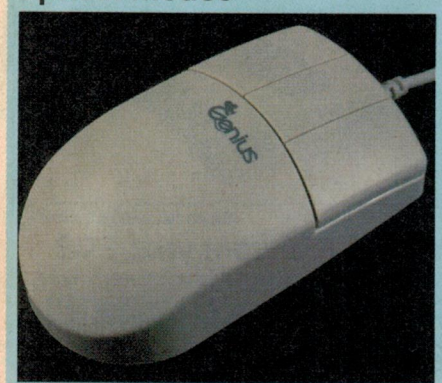
Communications kit for travellers

Established in 1992, communications company TeleAdapt has built its business on the growth in notebook computer users who depend on electronic communications via a fax/modem. The firm is now offering a special standard connection kit for A$59 which includes a line tester, TeleAdapt Windows help guide, airport transit guide, technical support publication and world plug guide. According to the company, this kit is a convenient way for a business traveller to be equipped for a quick and easy modem connection: "Simply tell us the country or region where you are travelling and we will provide a customised package."

Also available is an IBM modem saver for $45.50, claimed as an ideal means of identifying a useable analog telephone line, avoiding potential damage to the modem and the PBX interface, caused by higher voltages found on digital systems.

For further information circle 161 on the reader service coupon or contact Chris Ryan, TeleAdapt Ltd, 40 Dickson Avenue, Artarmon 2064; phone (02) 9433 8363. (WWW site at **http://www.teleadapt.com**).

Optical mouse



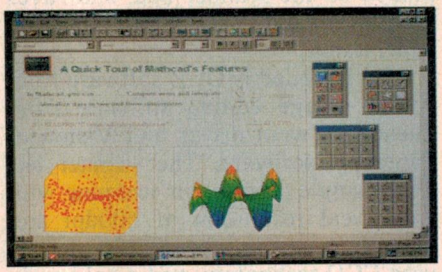
Genius has released the Terminator optical mouse, claimed to give 'pin point' accuracy. It comes with a special metal grid, said to give a smooth gliding action for the mouse. It also features an ergonomic shape and comes with Mouse Mate Software which allows users to configure the device to suit particular needs. It retails for $49.95.

For further information circle 165 on the reader service coupon or contact Milyn Imports, 4 Briar Court, Fulham Gardens, SA 5024; phone (08) 8235 2388. (Web site **http://milyn.in-sa.com.au/**)

Technical maths software upgrade

Mathsoft Inc, a provider of technical calculation and data analysis software, has released Mathcad 7 Professional, a major upgrade to the company's calculation software. It is designed to work with the Microsoft Office application suite.

Mathcad 7 Professional has a Windows 95 interface, more mathematical power, technologies for integrating applications, and new capabilities for Web-based collaboration. When used as a departmental standard, the program is



claimed to provide a unified framework for collaborative projects, streamlining activities and boosting the overall efficiency and accuracy of engineering, design and development processes.

The software is said to be an easy-to-use and powerful PC-based calculation tool that can solve problems from simple arithmetic to the most advanced symbolic algebraic and differential equations. It has object linking and embedding (OLE) technology to work with spreadsheets such as Microsoft Excel or Lotus 1-2-3. The RRP is $695.

For further information circle 164 on the reader service coupon or contact Hearne Scientific Software P/L, Level 6, 552 Lonsdale Street, Melbourne 3000; phone (03) 9602 5088. Web site **http://www.hearne.com.au**

Data/fax modem with duplex voice

The new Spirit Cobra SP is a voice and data/fax modem with a speaker phone and simultaneous voice over data (SVD) capabilities. It features a hands-free speaker phone that uses echo cancellation to overcome feedback problems and allows a full duplex, two-way voice link. The modem also has a headset.

The SVD function means users can speak over the top of a modem data connection. For example, two users in different offices can share an application that both have access to. Using this modem, application changes can be discussed as they are being made, making the modem suitable for video conferencing, software support and game playing with remote opponents.

Coupled with the supplied software, the modem's voice function also allows a computer to be used as an answering machine. The modem answers incoming calls, plays the recorded outgoing message, records incoming messages and stores them for replay. It also provides call forwarding with multiple mail-boxes.

The fax function lets users send and receive faxes while running other applications, and gives a choice of printing or deleting incoming faxes after viewing them on screen. The modem has an RRP of $249. An internal version costs $169.

For further information circle 167 on the reader service coupon or contact Mike Boorne Electronics, PO Box 8, Turramurra 2074; phone (02) 9906 6666. (Web site at **www.spirit-modems.com.au**).

Low power 16-bit MCU from Mitsubishi

Mitsubishi Electric Australia has announced an ultra-low power, compact 16-bit MCU core: the M16C. The new core processes instructions six times faster than the company's existing 16-bit M37700 core, which is the world's most popular 16-bit MCU (Source: Dataquest May 1996).

The M16C dissipates only 18mW of power at 2.7V and 7MHz (one wait state) and provides on-chip features to significantly reduce noise interference. It also boasts an industry-first ROM program correction feature, where a faulty mask ROM program can be corrected using an address-match interrupt and external EEPROM. This feature not only keeps debugging cost and time to a minimum, but also eliminates the need to re-manufacture the MCU from the mask. This frees the designer from accumulating defective stock and from losing customers due to shipping delays.

The M16C core takes advantage of both an accumulator and register-based architecture and provides high speed processing with RISC-like performance of 5MIPS at 10MHz timing. Optimised for C language programming, the processing speed of the M16C has also been significantly improved over the M37700 family, by implementing an easy-to-use instruction set.

Development support tools for M16C are also now available. A PC-based M16C Starter Kit can be purchased to evaluate the M16C performance and instruction set. The M16C Starter Kit consists of an evaluation board, assembler and Windows-based debugger, all in one inexpensive package.

For more information, circle 168 on the reader service coupon or contact Mitsubishi Electric Australia, 348 Victoria Road, Rydalmere, NSW 2116. ❖

WEBWATCH

presented by GRAHAM CATTLEY

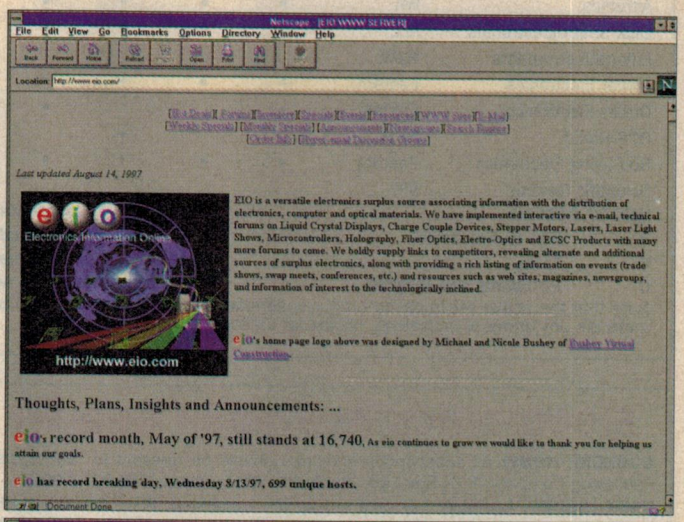
Electronics Information Online

http://www.eio.com

If you're interested in making your own laser light show, want to try your hand at holography, need information on talking to liquid crystal displays, or want to know all the ins and outs of stepper motor control, then this is the place to be. EIO is a service maintained by Electronics and Computers Surplus City, a retail company based in California.

The main feature of the site is the collection of technical forums on a range of subjects including charge coupled devices, stepper motors, lasers, microcontrollers and even holography. Each forum is split into two sections, one containing a list of articles, links and information on the subject, while the other provides an email message system where anyone can ask for (or provide) help on each subject.

They are always looking for people interested in writing articles, reviews or columns for the site — so if you have anything to contribute why not get in touch?



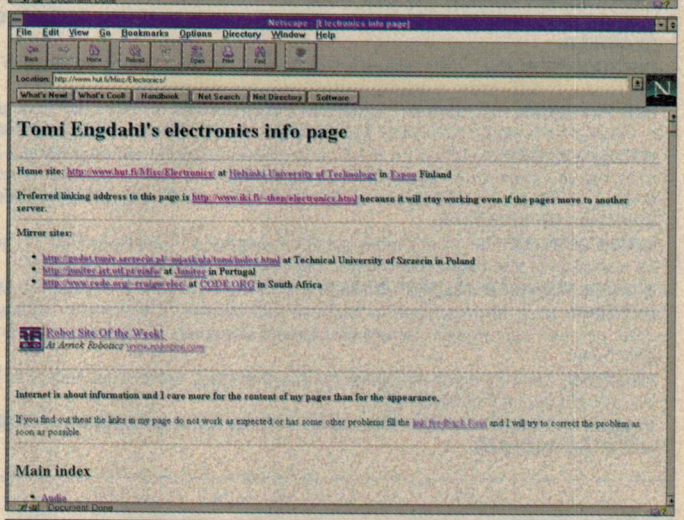
Tomi Engdahl's Electronic Info Page

http://www.iki.fi/~then/electronics.html

This site was brought to my attention by reader Harris Robertson, and while it isn't the flashiest site on the net, I would rate it as one of the most comprehensive electronics sites I've come across. There are literally *thousands* of HTML pages of useful, practical information on almost every aspect of electronics.

Tomi has obviously put a great deal of hard work into organising such a large amount of information, and as he says on the home page 'The Internet is about information, and I care more for the content of my pages than for the appearance'.

As a test, I decided to see what I could find on the subject of fuzzy logic. I ended up with an 11-page tutorial complete with diagrams, charts and source code. With such diversity (there are over 300 subject headings), you are bound to find the information you need. Thoroughly recommended!

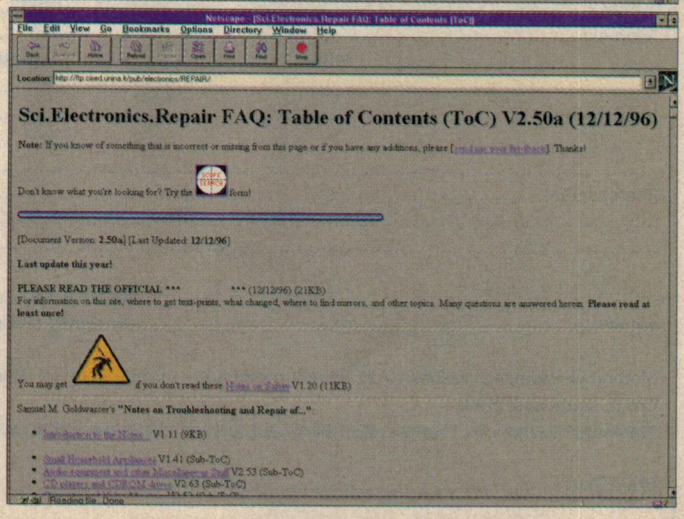


Sci.electronics.repair FAQ

http://ftp.cised.unina.it/pub/electronics/REPAIR/

Put together by Samuel Goldwasser and Filip Gieszczykiewicz, this site is probably best described by quoting the author's description: 'This is the (semi-official) Frequently Asked Questions (FAQ) for the newsgroup sci.electronics.repair. It is a body of knowledge that hopes to guide you when attempting to diagnose and repair just about anything that plugs into the wall or runs off batteries' — and that's indeed what it is.

As well as hints, tips and ideas, you'll find a great deal of relevant information on repairing anything from CD players through to photocopiers. There's info on connector pinouts, sources for manuals and schematics, as well as more general information, such as how to repair a switch-mode power supply. It all seems to be quite responsibly written, with a strong emphasis on safety. So if your VCR just ate your tape and you want to know the best way to remove it, or you are having troubles with your hifi, this is the place to go.❖



Come across any good sites that you think other EA readers would be interested in? If so, feel free to let us know — our email address is **electaus@magna.com.au**.

EA DIRECTORY OF SUPPLIERS

Which of our many advertisers are most likely to be able to sell you that special component, instrument, kit or tool? It's not always easy to decide, because they can't advertise all of their product lines each month. Also, some are wholesalers and don't sell to the public. The table below is published as a special service to EA readers, as a guide to the main products sold by our retail advertisers. For address information see the advertisements in this or other recent issues.

Supplier	State	A	B	C	D	E	F	G
Altronics	WA	•	•	•	•	•	•	•
Dick Smith Electronics	ALL	•	•	•	•	•	•	•
Emona Instruments	NSW						•	
Jaycar Electronics	Eastern	•	•	•	•	•	•	•
Oatley Electronics	Eastern	•			•	•		
RCS Radio	NSW			•				
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KEY TO CODING

A	**Kits and modules**	**D**	**Components**
B	**Tools**	**E**	**IC chips and semiconductors**
C	**PC boards and supplies**	**F**	**Test and measuring instruments**
		G	**Reference books**

Note that the above list is based on our understanding of the products sold by the firms concerned. If there are any errors or omissions, please let us know.

Electronics Australia Reader Services

SUBSCRIPTIONS: All subscription enquiries should be directed to: Subscriptions Department, Federal Publishing Company, P.O. Box 199, Alexandria 2015; phone (02) 9353 9992.

BACK ISSUES: Available only until stocks are exhausted. Price A$7.50 which includes postage within Australia only. **OVERSEAS READERS SHOULD ADD A FURTHER A$2.50 FOR EVERY BACK ISSUE REQUIRED.**

PHOTOCOPIES: When back issues are exhausted, photocopies of articles can be supplied. Price $7.50 per project or $15 where a project spreads over several issues.

PCB PATTERNS: High contrast, actual size transparencies for PCBs and front panels are available. Price is $5 for boards up to 100sq.cm, $10 for larger boards. Please specify negatives or positives.

PROJECT QUERIES: Advice on projects is limited to postal correspondence only and to projects less than five years old. Price $7.50. Please note that we cannot undertake special research or advise on project modifications. **Members of our technical staff are not available to discuss technical problems by telephone.**

OTHER QUERIES: Technical queries outside the scope of 'Replies by Post', or submitted without fee, may be answered in the 'Information Centre' pages at the discretion of the Editor.

READER SERVICES BULLETIN BOARD: (02) 9353 0627; ANSI, 24 hour access; any rate to 28.8kb/s.

PAYMENT: Must be negotiable in Australia and payable to Electronics Australia. Send cheque, money order or credit card number (American Express, Bankcard, Mastercard or Visa card), name and address (see form).

ADDRESS: Send all correspondence to: The Secretary, Electronics Australia, P.O. Box 199, Alexandria NSW 2015; phone (02) 9353 0620.

PLEASE NOTE THAT WE ARE UNABLE TO SUPPLY BACK ISSUES, PHOTOCOPIES OR PCB ARTWORK OVER THE COUNTER.

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Credit cards accepted:

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ADVERTISING INDEX

COLOUR MONITOR

NEW

New 12V DC-1A 6" colour monitor, no case, just the tube and driver PCBs, RGB inputs (some info might be available): **$65**

SUPER BRIGHT BLUE LEDS

BY FAR THE BRIGHTEST BLUE EVER OFFERED, super bright at 400mCd: **$1.50** ea or **10 for $10**

5mm LEDS AT SUPER PRICES

- 1Cd red: **10 for $4**
- 300mCd green: **$1.10** ea. or **10 for $7** (*make white light by mixing the output of red green and blue*)
- 3Cd red: **$1.10** ea. or **10 for $7**
- 3Cd yellow (small torch!) also available in 3mm: **10 for $9**
- Super bright flashing LEDs: **$1.50** ea. or **10 for $10**

NEW semiconductors

- CA3140 — MOSFET I/P opamp: **5 for $5**
- TL494 — switchmode power supply IC: **5 for $5**
- NE555 — timer IC: **10 for $5**
- ICL7106 — LCD display driver: **$5**
- CL7107 — LED display driver: **$5**
- IRFZ44 MOSFETS: 60V, 0.028 ohm on-resistance, 50A: **10 for $3**
- C8050 & C8550 transistor **20** for **$5**

NEW

CALLER ID

See the phone number of your incoming calls on an LCD screen while the phone is ringing. Has 80 call memory, dialler etc. Approved units should be available in October. Around $50!

110V AC FANS

New 4" fans: **$8**

PIC IC PROGRAMMER

Ready made, coming soon, email or fax for more information: **$49**

CHARACTER DISPLAYS

Back in stock late this month! Standard 32 x 4 character displays using Hitachi ICs. **ON SPECIAL: $18**

CCD IMAGE SENSOR

NEW

High quality "Thomson" brand, 576x550 pixels with antiblooming, with full data but no circuit suggestions, usable response from 400 to 1100nm, 30dB S/N at 40 milli-lux, 2/3" optics compatible format: **$35**

NEW COMPUTER CONTROLLED STEPPER MOTOR KIT

Similar to our previous stepper motor kit but with improvements so larger motors can be driven more efficiently, with much reduced loading on the computer's parallel port, and 2.5KV opto-isolation between the stepper driving circuit and the computer. Previous purchasers: contact us for a simple modification to greatly reduce the loading on the computer's parallel port. PCB and all on board components kit plus software and information: **$39** or with two M35 motors: **$49**

MINI TV STATION

Make your own mini TV station with this metal cased, commercial transmitter with telescopic antenna. Dimensions 123 x 70 x 20mm, 12V operation. Includes power switch, indicator LED, RCA audio and video connectors, twin RCA-RCA lead. Our 32mm AUDIO PREAMPLIFIER kit with electret microphone (**$8**), and a CCD camera completes the station. Transmitter: **$30.** When purchased with a CCD camera **$20**. Regulated 10.4V-500mA plugpack to suit: **$10**

12V - 2.5W SOLAR PANEL KIT

Amorphous solar panel and glass backing: **SPECIAL $20** ea, **4** for **$60**

BEST VALUE CCD CAMERA

The best "value for money" CCD camera on the market! See us for a comparison to advertised cheaper models! We do not need to make you BEWARE! Tiny CCD camera, 0.1 lux, IR responsive, high resolution. This camera has a metal lens housing (not plastic) and performs better than many cheaper models. No surcharge for credit card orders! A pinhole lens version also available for the same price: $120 Yes, that's for just one camera and you don't need to be in a plan costing you thousands of dollars for quantity discounts: Just ring!! SALES TAX EXEMPT PRICE FOR EITHER CAMERA: **$99**. For different lenses, ring us!

Coming: A **lower priced** high quality standard or pinhole CCD camera. Quality product for under **$100**. Fax/ring or email for more info.

COLOUR CCD CAMERA - NEW

This high quality CCD camera is built over 3 boards which are joined with a flexible cable that can be folded into a very compact camera. Head board: 42x20.5mm, lens height: 24mm. Main board: 42x42x9mm. Power board 42x20.5x8.8mm. ***SPECIAL introductory price:*** **$350**, less with sales tax exemption.

KITS FOR CCD CAMERA SECURITY

New INTERFACE KIT FOR TIME LAPSE RECORDING: now has relay contact outputs! Can be directly connected to a VCR or via a learning remote control: **$25** for PCB and all on-board components, used PIR to suit: **$12**.

- **32mm 10 LED IR ILLUMINATOR** new IR (880nm) LEDs have an output about equal to our old 42 LED IR illuminator: **$14.**
- **32mm AUDIO PREAMPLIFIER** An **$8** kit that produces a 'line level' signal from an electret microphone, connect the output to our:
- **UHF VIDEO TRANSMITTER** (**$30**) or **$20** when bought with the camera. for a complete Audio-Video link.

32mm AUDIO AMPLIFIER: An LM380 based **$9** audio power amplifier which can directly drive a speaker — needs the 32mm preamplifier. *WHAT IS 32mm?* All boards are 32mm dia, so you can house these kits in a plastic 32mm joiner: cheap plumbing part.

FAX POLLING

Back by popular demand. Poll (02) 9570 7910 and (02) 9579 4985. Updated monthly.

BARGAIN ARGON LASER HEADS

Cheapest way to get a BLUE-GREEN LASER beam! These used argons have around 30mW output (may need a licence), 6 mth guarantee. Power supply based on a transformer with 80V @ 2A and 3V @ 20A secondaries. Ring or email for more info. Head only: **$250**.

NEW

LASER ENGINE

Brand new complete laser engine as used in laser printers. Includes a polygon scanner motor with xtal controlled driver PCB, 5mW/780nm laser diode in collimated housing mirrors/mirrors lenses etc. Information on making motor and laser operational included. Bargain at **$35**

5mW/650nm LASER POINTER KIT

YES, NEW 650nm kit. Very bright! Complete laser pointer that works from 3–4V DC. Includes 650nm/5mW laser diode, new handheld case 125x39x25mm, adjustable collimator lens, PCB battery holder: (K35) **$35**

AUDIO - VIDEO MONITOR

2ch compact high res 5" screen B/W audio and video monitor. 12V DC 1A. Monitor and 6-way mini input connector only: **$125**

AMPLIFIER - PREAMP AND MORE

A professional mostly SMD PCB with a 5W amplifier based on a TDA1905 IC, and a separate audio preamp. We also include a prewired high quality unidirectional electret mic with wind filter and mounting clip, a small speaker and hook up info. Probably from a communications system. Great for many applications such as a two way intercom that doesn't require switching (needs 2). Less than the cost of the electret mic. **$15 ea, 2 for $24.**

SOLAR REGULATOR

Ref: EA Nov/Dec 94 (intelligent battery charger). Efficiently charge 12-24V batteries from solar panels, but can also be used with simple car battery chargers to prevent overcharging. Very high efficiency due to MOSFET switch and Shottky diode. 7.5A or 15A kit: **$26/$29** (K09)

MASTHEAD AMPLIFIER KIT

Our famous MAR-6 based masthead amplifier. 2-section PCB (so power supply section can be indoors) and components kit (K03) **$15.** Suitable plugpack (PP2): **$6** Weatherproof box: (HB4) **$2.50**. Box for power supply: (HB1) **$2.50** Rabbit-ears antenna (RF2) **$7** (MAR-6 available separately)

BOSSMAN ELECTRONICS

A new subsidiary company to OATLEY ELECTRONICS, for giving TAX EXEMPT PRICES to entitled organisations. Product range will increase rapidly.

Phone (02) 9584 3562

PC POCKET SAMPLER KIT

Data logger/sampler, computer controlled chart recorder, slow speed scope. Incredible value value **$30**

DISCO LASER LIGHT SHOW PACK

The above 5mW/650nm kit plus our AUTOMATIC LASER LIGHT SHOW: **$99**

650nm LASER POINTER SPECIAL

Light weight 2 x AAA pen-size pointer with 650nm laser, very bright: **$55**

650nm LASER MODULE

Our new module has a 650nm laser diode. Very bright! **$50**

VISIBLE LASER DIODE MODULE KIT - COMING SOON

Same circuit as our "visible laser diode kit" but a smaller PCB (25 x 50mm, WxD) that fits into tubing. 650nm/5mW laser diode, 3V: **$29**

NICAD CHARGER & DISCHARGER

Professional, SMD, switch mode, assembled and tested NICAD battery charger/discharger PCB assembly. For fast-charging 7.2V AA nicads. Basic info provided, plugpack not included. *Bargain:* **$9** ea or **3 for $21**

NICAD BATTERY SPECIAL

New 1.2V-400mAh cells wired in packs of 6. Each pack has a thermal cut out switch, each cell is 16 x 45 x 5mm, as used in mobile phones, 6 packs (30 batteries): **$10**

DIGITAL BAR CODE WANDS

NEW

New, US made wands fitted with 2.5m curly cord terminated in a 5-pin 240º DIN plug. Contains an optical sensor, visible red LED, a photo IC detector, and precision aspheric optics. Converts bar codes into a digital pulse train as it's manually swept across the bar code. Uses a sapphire tip, pot size 0.19mm. Open collector TTL/CMOS compatible output, powered from 5V: **$45**

3-STAGE IMAGE INTENSIFIER TUBES

Back in stock. Make a high resolution night scope that works in starlight! Three tubes, the inverter kit and a suitable eyepiece. Housing and front lens not supplied: **$250**

CHARACTER DISPLAYS

Back in stock late this month! Standard 32 x 4 character displays using Hitachi ICs. **SPECIAL: $18**

12V/7Ah GEL BATTERY BARGAIN

Fresh stock 7Ah battery (150 x 95 x 65mm, 2.7kg) and one gel/lead-acid battery charger: **$33**

DC MOTOR SPEED CONTROL-EXPERIMENTERS PACK

NEW

One 20A motor speed controller kit (similar to SC - Jun 97) **$18,** plus two small new 12V DC motors (40mm dia, 40mm long) plus one used car windscreen wiper motor (has internal gear reduction) for: **$32**

COMPUTER POWER SUPPLY

NEW

New, complete PCB assembly only. Size 45 x 108 x 200mm. Switchable 120/230V AC input. DC outputs: +5V/6A, +12V/1A, -12V/1A, -5V/1A. Circuit provided, RU approval. Modern design. Mains input - not for the inexperienced! Be quick: **$16 ea** or **4 for $56**

VERY EFFICIENT WHITE LIGHT - LCD DISPLAY

NEW

Brand new "second grade" (few missing pixels) Sharp 640x480 LCD display (LM64P722) with a very efficient "state of the art" cold cathode BL fluorescent lamp (5mm dia, 150mm long) which is very easy to remove! Produces useful white light at about 1-3W AC input! Lamp has a 10,000hr life! Removing the display reveals a uniformly lit 150 x 200mm backplane. Complete display plus BL inverter kit (needs 12V/150mA): **$15** Data sheets (11 pages) for a similar display: **$2**

12V GEL BATTERY BARGAIN

Guaranteed Panasonic '94 date code 12V gel batteries! New, 2.3Ahr, 180 x 80 x 22mm, 0.67kg, as used in video equipment etc. **$10 ea**. That's a bargain but! **Two** batteries and an SLA charger: **$25!**

OATLEY ELECTRONICS

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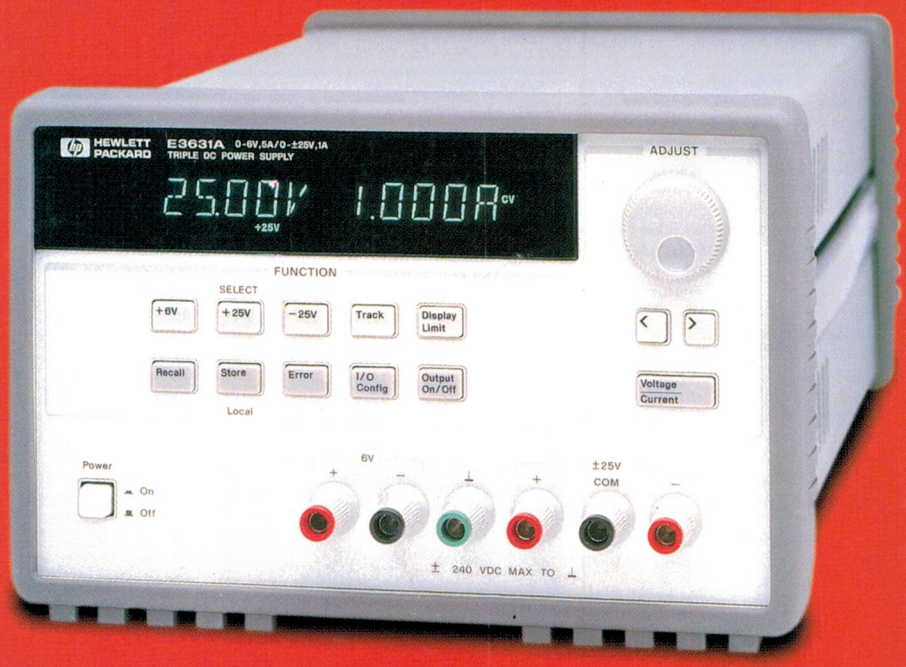
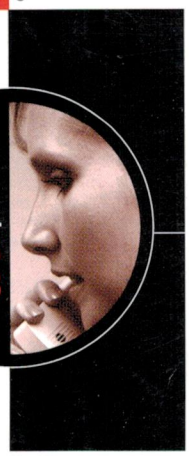
OK, so power supplies aren't the most *exciting* things in the world.



But programmability, triple outputs and clean power at this price is at least *interesting*, isn't it?

Getting more than you expect for less than you expect is never boring.
You probably won't jump up and dance at the news, but you probably will recognize the great value offered by the new HP E3631A triple dc output supply. The triple outputs with 80 W total power (0 to +25V, 1A; 0 to 6V, 5A) give you lots of flexibility. The built-in HP-IB and RS-232 ports make it ready for automation. And low noise and tight 0.01% regulation give you clean power you can count on for better measurements.

This family's full of interesting characters.
The HP E3631A is part of the HP E3600-series, value-priced bench power supplies that offer a wide range of functions and power ratings. So call us and we can help you select the one that fits your needs perfectly.



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